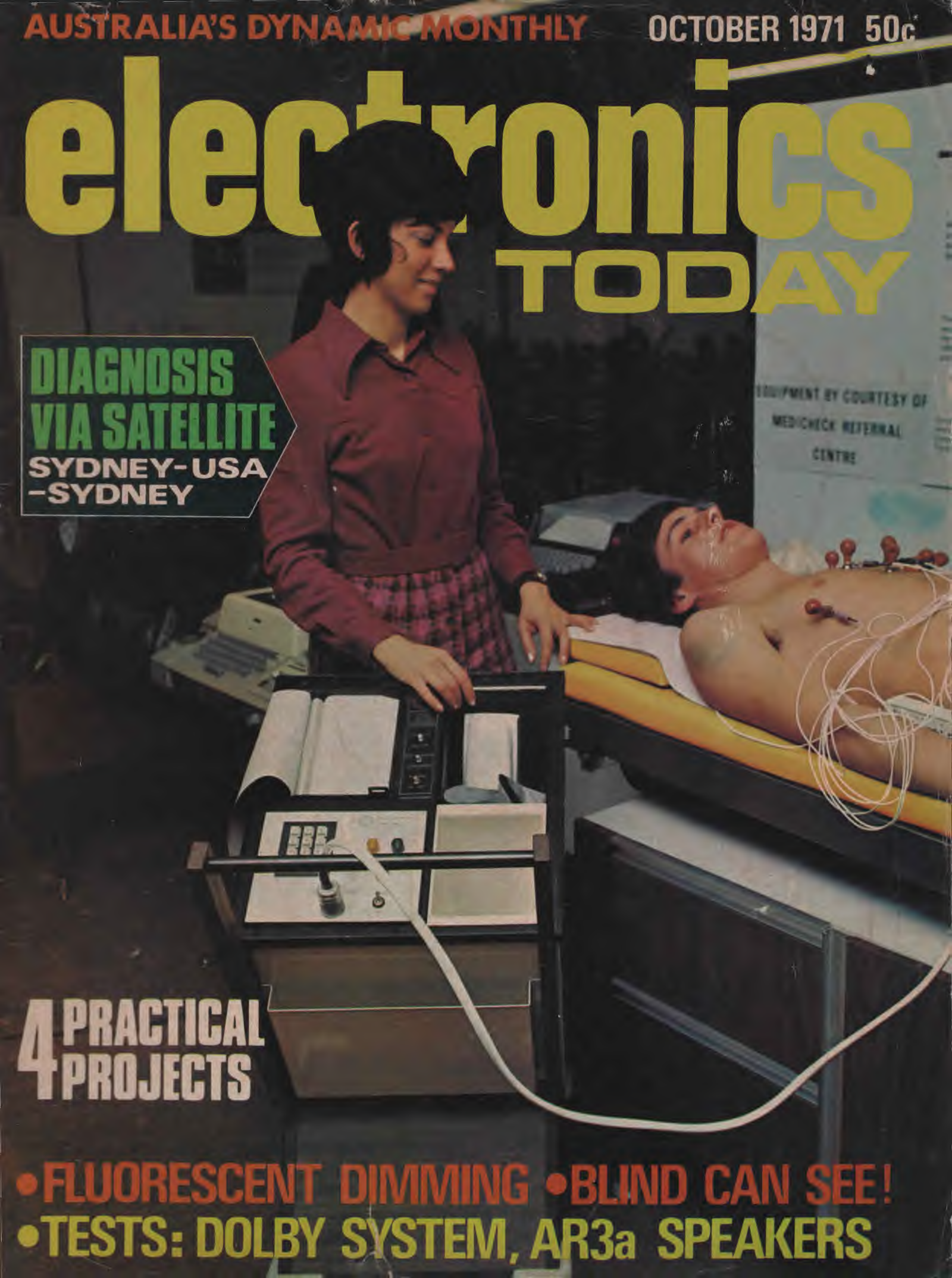
AUSTRALIA'S DYNAMIC MONTHLY OCTOBER 1971 50c

electronics TODAY



DIAGNOSIS VIA SATELLITE
SYDNEY-USA -SYDNEY

4 PRACTICAL PROJECTS

- FLUORESCENT DIMMING
- BLIND CAN SEE!
- TESTS: DOLBY SYSTEM, AR3a SPEAKERS

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, RIAA 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.

TC-366 TAPE DECK— slanted horizontally or vertically

Here's a new functional angle on tape decks — Sony's latest — TC-366! Unique slant front gives easier operation — vertically or (changed around) horizontally. Professional 3 head system for playback, recording and erase. Auto. shut off. Servo control tape transport reduces flutter and wow and ensures incredibly smooth and steady reel drive with optimum tape tension. Mixing facility. Tape selector. Easy threading. Two metres. Low distortion pre amp. The superior sound quality of TC-366 mates beautifully with Sony's latest stereo amplifier — TA-1144 — a compact masterpiece of design excellence.

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

Please send me information on the Sony TA-1144 Amplifier and the **TC-366** Tape Deck.

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electronics TODAY

OCTOBER Vol. 1. No. 7

main features

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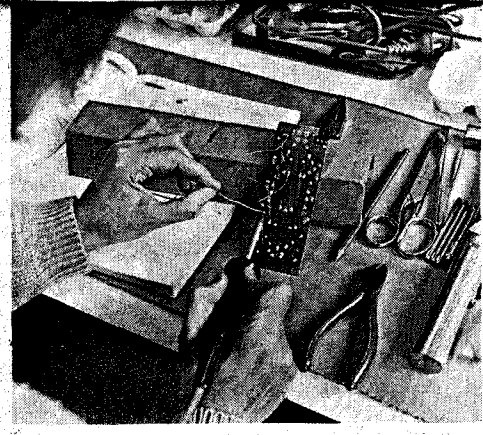
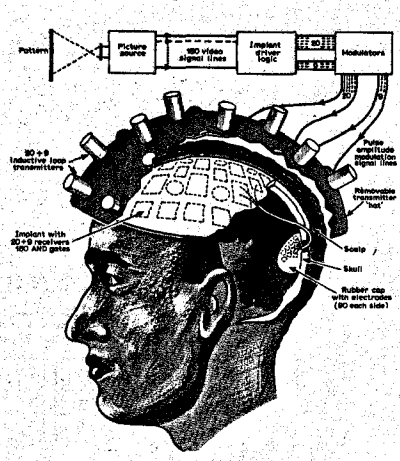
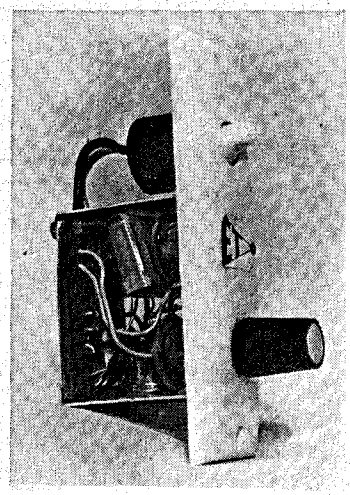
reviews

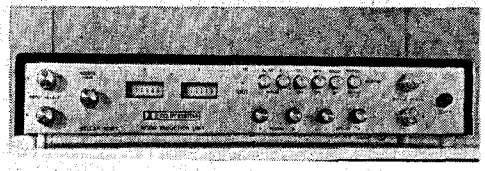
news & information

COVER: In Sydney, electronic equipment is monitoring a patient's heart condition – meanwhile a satellite-linked computer in the USA is analyzing the data – a complete diagnosis is then returned to Sydney – all within seconds. (details on page 43).









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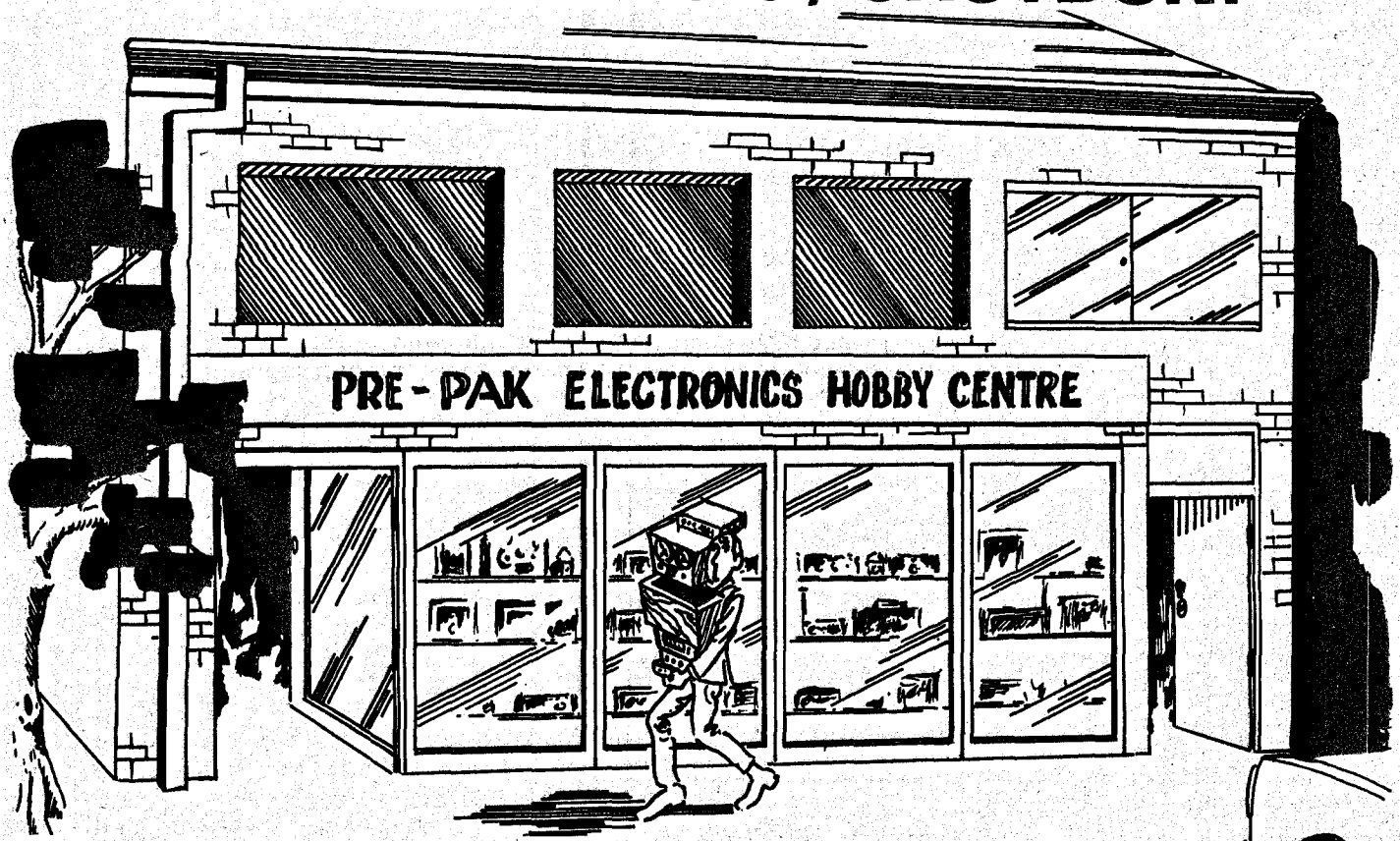

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A FEW OF OUR REGULAR BARGAINS . . . .

CASSETTE TAPE RECORDER KIT
Complete kit, pre-assembled amplifier board and mechanics — full instructions supplied $29.95
Batteries not included Post 1.00

7 TRANSISTOR RADIO KITS
Complete kit with instructions and carrying case. Battery not included. Easy to assemble, attractive case. $7.95

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All timber pre-cut to exacting specifications, featuring a special "iron-on" veneer. Sarlon grille Innerbond included. See August issue Electronics Today for details. Special offer — Magnavox 8-30 kit $22.50

PROJECTS AND KITS

Z30 20W amp	$14.90
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Stereo sixty pre-amp and control unit	$34.25
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Demonstration facilities now available!

Sinclair Project 60
Now available, only from Pre-Pak. Special model PS-8 power supply. Same as PZ-8 but also has overload protection .. $27.50

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Hi-fi a time to join forces

For years, hi-fi had been the province of out-and-out enthusiasts. This is no longer so.

In ever-increasing numbers, the general public are realising that high quality sound reproduction is not just a luxury for the connoisseur. For this reason alone, the hi-fi industry cannot help but grow.

But the industry must realise that a large proportion of their future customers will be relatively unsophisticated people to whom technical specifications and even subjective evaluations have little meaning. And because of this lack of knowledge Mr. Average Buyer is likely to get talked into purchasing an overpriced cocktail cabinet with little else than a gilded hi-fi label, instead of a properly designed and engineered system.

Even the semi-knowledgable buyer finds it difficult to evaluate competitive equipment because of a lack of generally recognised standards.

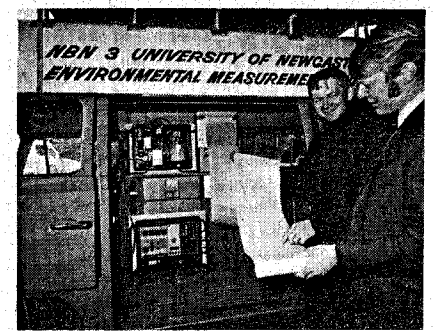
From many of our readers' letters and telephone calls we know this is a rapidly growing problem which the Australian hi-fi industry must face and resolve.

Electronics Today suggests that the industry should seriously consider forming an association to establish recognised standards and work together to promote their common interest.

To this end, we at Electronics Today offer whatever assistance may be required. Such an association must surely benefit us all — manufacturers, distributors, consumers, and everyone else who is involved in the rapidly growing, exciting world of hi-fi.

news digest

POLLUTION REPORTS



Newcastle residents will soon have new information added to their weather reports — the level of air pollution.

Newcastle University has taken delivery of pollution monitoring equipment which can detect the level of sulphur dioxide in the air. The University, in conjunction with Newcastle television station NBN 3, has equipped a Volkswagen Kombi van with instruments to measure the levels of sulphur dioxide, carbon monoxide, dust and haze.

Philips Industries Limited supplied the sulphur dioxide detection equipment, which is being widely used overseas in large industrial areas. It works by sampling surrounding air and automatically analysing it for chemical content.

The monitor is attached to chart recording equipment which gives a continuous visible indication of pollution levels.

The instrument uses a principle, in which sulphur dioxide is measured by continuous titration with bromine gas, the latter being generated electrolytically in a solution in which the sulphur dioxide is absorbed. A feedback amplifying system controls the bromine — generating current, so that the net rate of bromine generation equals the rate of sulphur dioxide absorption. This creates a net electrical current proportional to the sulphur dioxide concentration in the incoming gas stream.

The air-stream is kept constant with the aid of a critical orifice, and a vacuum pump. The air intake is separate to the actual monitor. It can be fitted to the top of a streetlamp for convenience.

ORBITING SATELLITES AID MODERN MARINERS

A small, ocean-going computer is the heart of a satellite navigation shipboard system which can now pinpoint the position of a ship anywhere in the world, regardless of the weather, time of day or distance from land.

Navigation by radio signals is almost as old as wireless communication itself but modern shipboard systems now in wide use would surprise any old-time mariner, for he can now watch a teletype automatically print out the latitude and longitude to within 150 feet of his actual position.

These shipboard systems use a minicomputer only a few cubic feet in size. Yet coupled with a specialized communication receiver it is powerful enough to automatically digest information transmitted from orbiting satellites and print out a ship's longitude and latitude on a teletype.

More than 60 shipboard navigation systems built and programmed by Magnavox (USA) are now in use. Most of them are controlled by Hewlett Packard mini-computers. About half the systems are aboard oceanographic research or support ships. The other half are used by navigators of oil exploration ships, commercial transports, passenger ships, cable laying ships and Navy and Coast Guard ships.

Selling sound to Australia — and selling for less!

Here's positive proof that Douglas Trading gives you extra purchase power . . .

GLORIOUSLY STYLED SANYO 3 speed, 4 track, stereo tape deck. Piano key operation, timber case, HI-FI performance. Fantastic value! **ONLY $139**

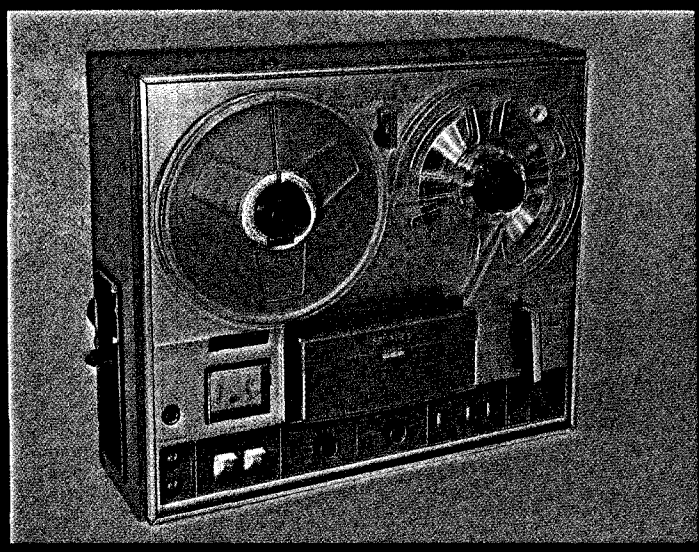
AKAI X-160 D

FINAL RELEASE!

Following sensational sell-out, further 80 released from bond! World patented cross field heads, etc.

FULL PRICE $229

Rush your order today!



AUSTRALIA-WIDE EXCLUSIVE! A scoop purchase of 500 of these stupendous SONY 3 head, 4 track, stereo decks brings the price plummeting down to only $199. Don't wait for a leaflet — post your cheque! **ONLY $199**

Amazing deal on this **NATIONAL AUTO-REVERSE** 4 head, 4 track, 3 speed, twin capstan Professional Tape Deck!

Hurry — limited stocks!

FULL PRICE $199

PIONEER HI-FI STEREO TUNER AMPLIFIER ONLY $139

Model AX330. Bass/treble/loudness control, tape monitor, AM tuner with tuned RF stage, black light dial, 12 watts RMS. Brand new in sealed cartons. Full warranty. Rush these!

Douglas Trading does it again — 2 colossal bargains!

Don't miss this one! PE 4 speed HI FI Gramo Unit, anti-reverb suspension, turnover ceramic cartridge/pick up lift, teak and plexi cover. Ideal for connection to tape recorders. Full price — a sensational **$29 COMPLETE.**

Here's more colossal value in a good quality pick up arm standard plug in head shell, twin gimbal bearings, anti-skate. **ONLY $14 FULL PRICE.**

Don't hesitate to write for further information. Post your order and cheque direct . . .

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Already discerning enthusiasts have set two recently released

Amplifiers

Both Sansui products . . . the Model 210A stereo tuner/amplifier and the Model AU-101 stereo control amplifier . . . offer extraordinary value for money. In terms of sheer performance no other similarly priced amplifier available in Australia today can match or surpass the 210A or the AU-101, including some products *twice the Sansui price.*

SANSUI MODEL AU-101 STEREO AMPLIFIER
Two leading Australian electronics magazines have reviewed the all low-noise silicon transistor Sansui Model AU-101. ***"Electronics Australia"*** (August, 1971) says . . . *"the best comment we can make about the AU-101 is that few amplifiers, regardless of price, give an overall test result as good as this. This makes it a real bargain at the very reasonable price of $138".* ***"Electronics Today"*** (May, 1971) says . . . *"Surprise Packet" . . . "Performance of the Sansui AU-101 belies its low price" . . . "The hum and noise performance are both very good and better than most other amplifiers at twice the price" . . . "The Sansui AU-101 is a very good buy, particularly at the price".*

There you are . . . unbiased comments from two leading publications. What precisely does the Sansui AU-101 offer? Look at these specifications!

AU-101 Specifications:— ● Music power: *50 watts at 4 ohms, 44 watts at 8 ohms.* ● R.M.S. power: *36 watts at 4 ohms, 30 watts at 8 ohms.* ● Total harmonic distortion: *Less than 0.8% at rated output.* ● Frequency response: *20-60,000 Hz. ± 2 dB.* ● Channel separation: *Better than 45 dB.* ● Input sensitivity: *3 mV. (Magnetic cartridge), 4 mV. (Microphone), 200 mV. (Auxiliary and Tape Recorder).* ● Dimensions: *16" x 11" x 4⅝".* ● Price: *$138* (Suggested list price inc. sales tax).*

SANSUI MODEL 210A STEREO TUNER/AMPLIFIER
The recommended list price of the Model 210A stereo tuner/amplifier is only $185*. Power output is 34 watts music power into 4 ohm speaker systems or 22 watts R.M.S. Frequency response is 25-30,000 Hz. ±2 dB. and extends well beyond this figure. Sensitivity of the power amplifier suits magnetic cartridges at 3 mV. and 180 mV. sensitivity caters for auxiliary inputs and tape recorders.

An easily read panoramic tuning dial simplifies selection of radio stations on AM/MW or AM/SW bands; a signal strength meter operates on the AM band. Selectivity is an almost unbelievable 40 dB. making the 210A the *most selective receiver Sansui has ever made.* This radically improved selectivity is directly attributable to Sansui's use of two ceramic filters each with two filter elements in the 210A's I.F. amplifier section. A whistle filter eliminates unpleasant interference and noise on weak AM stations. Every desirable control is provided in the Sansui 210A . . . a DIN socket for tape recorders, headphone jack, flexible bass and treble controls, a direct tape monitor switch, loudness control and clearly marked selector switch.

When you call at your franchised Simon Gray dealer to hear the Sansui 210A, *listen critically.* You'll be agreeably surprised with the audible difference Sansui quality makes. Only Sansui — Japan's leading audio only manufacturer — could design and manufacture an outstanding stereo tuner/amplifier expressly for Australian conditions and keep the price down to only $185*!
Call and see your Simon Gray dealer!

***IMPORTANT: Prices quoted in this advertisement are suggested consumer prices only.**

Sansui

Simon Gray Pty. Ltd.

Sansui Distributors: Australia, excluding W.A.: Simon Gray Pty. Ltd. **Head Office:** 28 Elizabeth Street, Melbourne. 3000. Tel. 63 8101*. Telex: 31904. **Sydney Office:** 53 Victoria Avenue, Chatswood. N.S.W. 2067. Tel. 40 4522*. **Canberra Office:** 25 Molonglo Mall, Fyshwick, A.C.T. 2609. Tel. 95 6526. **Adelaide Office:** 301 South Terrace, Adelaide, S.A. 5000. Tel. 23 6219. **N.T.:** Pfitzner's Music House, Smith Street, Darwin. 5790. Tel. 3801. **Qld.:** Sydney G. Hughes, 154-158 Arthur Street, New Farm, Brisbane. 4005. Tel. 58 1422. **Tas.:** K. W. McCulloch Pty. Ltd., 57 George Street, Launceston. 7250. Tel. 2 5322. **W.A. Distributors:** Carlyle & Co. Pty. Ltd., 1-9 Milligan Street, Perth. 6000. Tel. 22 0191. **Sansui equipment is manufactured by:** Sansui Electric Co. Ltd., 14-1, 2-chome, Izumi, Suginami-ku, Tokyo, Japan.

Australian stereo new sales records for SANSUI AMPLIFIERS.

surprising.

Ask for full details. Send the coupon right away and we'll send you all the facts!

Simon Gray Pty. Ltd.,
28 Elizabeth Street,
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Please send me complete technical details on the Sansui Model 210A/AU-101 and the name of my nearest Simon Gray franchised dealer.

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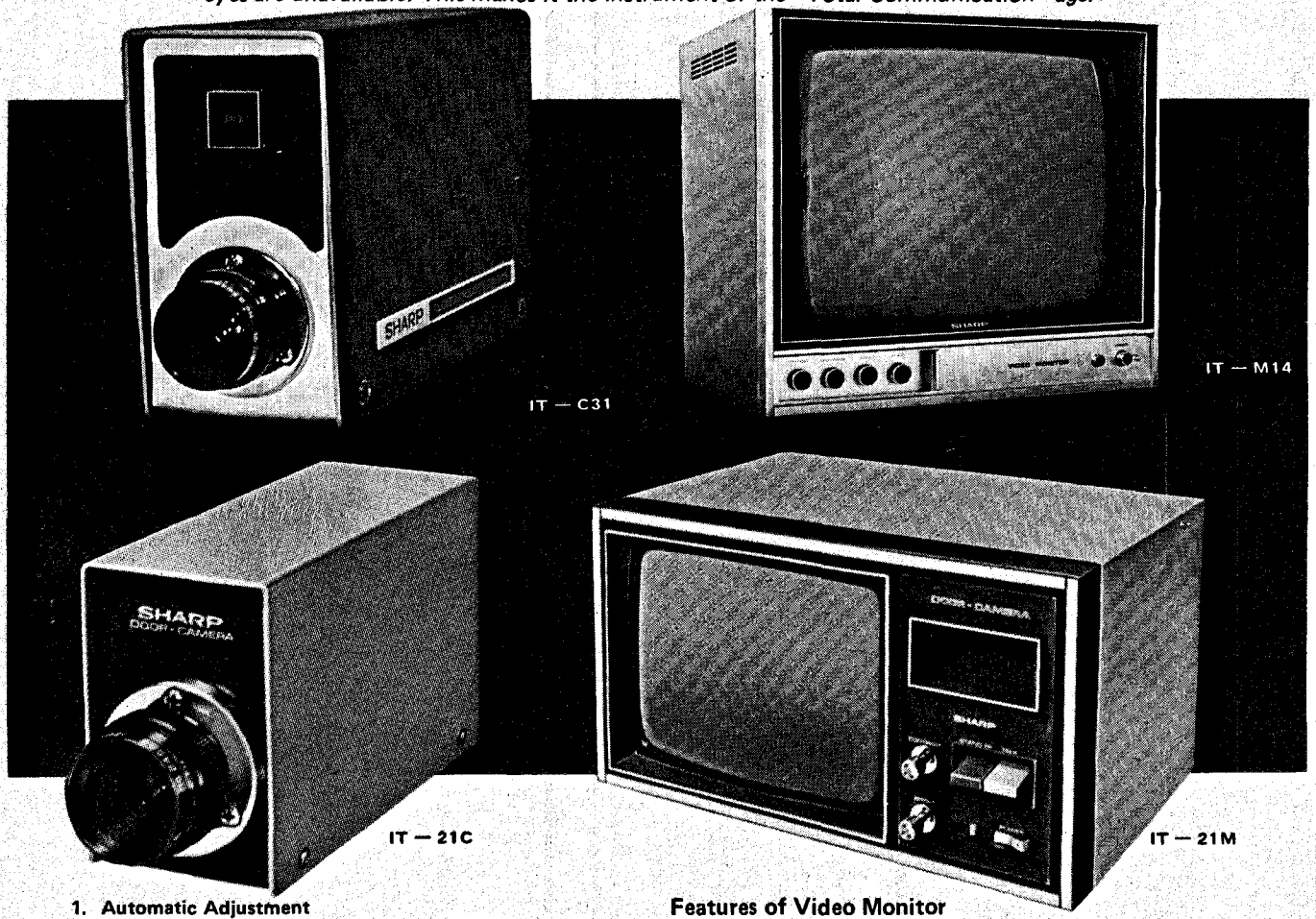
SHARP CLOSED CIRCUIT TELEVISION
Enables TOTAL COMMUNICATION

Man-made Cameras, however excellent, can never match the human eyes in their exquisite and accurate functions. However, how can we watch or observe things in unapproacheable or dangerous places? How can a single man observe many places at one time or give the same visual information simultaneously to many people? The Sharp CCTV apparatus is capable of performing watches and observations where human eyes are unavailable. This makes it the instrument of the "Total Communication" age.



1. **Automatic Adjustment**
   Adjustment of sensitivity is automatically regulated according to the brightness of the object being photographed (with built-in EE circuit).
2. **Built for strength and durability under all conditions**
   Demonstrates remarkable strength and stability against changes in temperature, humidity and voltage.
3. **Clearness of picture**
   Video output (EET adapted) results in clear, well-defined picture.
4. **Easy handling**
   Small in size, light in weight. Connected easily to the receiver by a coaxial cable.

Features of Video Monitor

1. **Clear picture so you can see every detail.**
   Clear picture is obtained by 4 transistors used in the video amplifier. So it can be used for medical or scientific experiments in which super clear picture are required. When used in combination with a superb camera, it gives you a perfect performance.
2. **Easy setting! Multiple monitors can be connected in parallel.**
   Both input and output connectors are provided at the signal input part, so multiple monitors can be operated at a time by "bridge connection". No video distributor is required, so wiring is easy.
3. **Easy and inexpensive to maintain.**
   Because of its all transistor circuit, it consumes very little power. It is economical to use — even when kept on all day.
4. **Solid and decorative.**
   Highly durable metal cabinet for industrial use, and beautifully designed too.

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news digest

Developed originally for Navy submarine use, but since made available to non-military users, the Transit navigation system is based on five orbiting satellites. They circle the earth in their six-hundred-mile-high orbits every 1 hour 45 minutes transmitting positional data to any ship in need of the information.

Shipboard equipment with 600 foot accuracy for receiving and translating the data from the orbiting satellites costs about $30,000 per vessel. Systems with 150 foot accuracy cost around $65,000.

Because a ship's course can be plotted more closely than ever before, some commercial transports report cutting as much as a day off their travel time between the United States and the Far East using the less expensive systems. And since it costs as much as $20,000 per day to operate many large vessels, it doesn't take long for satellite navigation to achieve considerable savings.

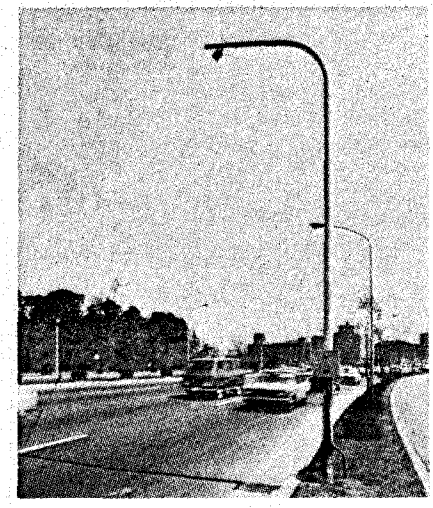
Since the shipboard system is computer controlled, positional data is printed automatically, approximately every 20 minutes. The minicomputer controls the collection of data by a specialized radio receiver, processes the information and prints out the position on a teletype machine.

A typical printout from a complex integrated system that takes motion information from additional devices looks like this:

```
000111001111111111111111111111111100000
                  ↑↑
SAT FIX MAPS-20127

DAY   TIME      LATITUDE          LONGITUDE
290   0918      033  50.459 N     118  20.272 W

HDG   SPD       ANT    ITER       ELEV
000.0 000.0     +0013  02         40

 SAT ID = 7464.57
```

The top row of zeros and ones and the two arrows tell the operator where the center of the satellite pass occurred and when data was taken. "SAT FIX MAPS-20127" identifies the programme, or set of instructions which control the computer and the system. Then, the day of the year, the 290th, the time in Greenwich Mean Time and the latitude and longitude in degrees and minutes are printed. Heading and speed information follow, whether entered automatically by an integrated system or entered manually. Next, the antenna height above sea level is printed. The mnemonic "ITER" refers to the number of times data is taken from the satellite pass is near the horizon, this number may be high indicating a weak signal and possibly poor positional data. "ELEV" refers to the satellites elevation in degrees above sea level. The last line identifies the satellite just tracked. Although the navigator needs only the positional data found in the third line, the heading and speed data remind him of data previously entered. Since the system picks up every satellite transmission within range, the additional information provides a means of judging the quality of the data received.

TRAFFIC CONTROL SYSTEM IN TOKYO



The traffic control system in Tokyo is one of the most advanced methods in the world for controlling traffic in a large area. In this sytem a computer determines the most advisable intervals for red and green traffic lights according to the rate of traffic congestion in order to ensure a continuous flow of road vehicles.

The Metropolitan Police Office recently installed the system in the centre of Tokyo to assist in relieving traffic congestion.

Indicators which count the number of passing vehicles are placed at strategic points along the roads and this information is fed into the computer at the Metropolitan Police Office. The computer assesses the degree of congestion at each intersection, calculates the most suitable times for signals to ensure maximum traffic flow and immediately sends instructions to each signal unit. As a result, the duration of green lights is prolonged on congested streets and reduced when the contrary is the case.

The procedure is now being applied at 128 crossroads in an area of 5km^2 around the Tokyo railway station, busy streets in the Ginza district and govern-

news digest

ment offices complex in Kasumigaseki. The system will be extended to cover 263 additional crossroads during the current fiscal year and 2000 crossroads by the end of 1975. In this way all signals at the main intersections in an area of 178 km² from the centre of Tokyo will be controlled by computer.

The Metropolitan Police Office is now conducting an enquiry into the effects of the new system. It estimates that the traffic flow has been improved by 20% to 30%.

How it's done

In broadcast television, the video signal is composed of the lines containing the actual picture information, lines containing field-synchronization signals, and lines containing no information used during the field-blanking interval. The ITT system places the sound signals, in a time-compressed form, into these latter lines.

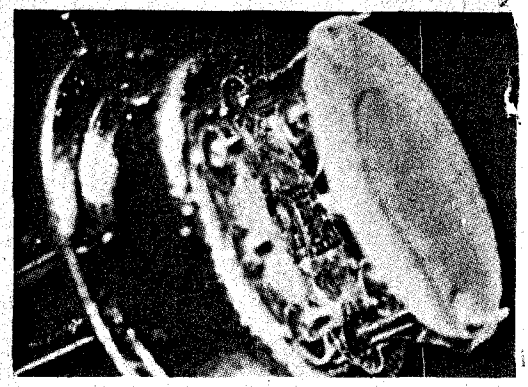
There have been several earlier proposals for including additional sound information within the picture signal, but these have permitted only four different sound signals within the existing television standards. With the ITT system up to 12 sound signals with theoretical high-fidelity bandwidth of 13 kHz each can be handled, or up to 24 signals each with a theoretical bandwidth of 6.5 kHz.

To achieve this, amplitude-modulation transmission is used. Each sound signal is sampled at regular intervals and analogue samples are stored until the end of a video field, when they are read out at high speed during one idle line interval. By this method, on the European 625-line system each sound channel, corresponding to each 20 ms of a video field, is compressed by 1/385 and transmitted during the line time of 52 μs as an integral part of the video signal.

At the receiver, the specific sound channel is extracted by time selection of one idle line signal, feeding the sound information on it into an information storage device that is read out into the sound amplifier during the next field period. For transmission of 24 sound signals, the time compression factor is 1/770th.

Each sound signal is sampled and stored during two succeeding field periods, then transmitted in time-compressed form during 52 ms of one idle line to the receiver storage. This time compress signal is then read out during two succeeding field periods.

"CANNED OSCILLATOR



The F3187 — believed to be the first complete quartz crystal oscillator to be packaged in a tiny can, no bigger than a garden pea — is announced by the Specialized Components Division of Marconi Communication Systems Ltd., of Britain. The components which make up the oscillator — the crystal (the large white disc) and a complete microelectronic integrated circuit comprising transistors, resistors and capacitors — are all contained within a transistor can, which is less than 9mm diameter and 7mm high. The F3187 will provide accurate and stable frequency control in situations where reliability, ruggedness, compactness and light weight are key design factors.

ENDEVCO

Simon Gray Pty. Ltd. has been appointed Australian Distributors for Endevco of Pasadena, California.

Products in the Endevco range to be marketed in Australia include guidance and control grade servo accelerometers, piezoelectric and piezoresistive transducers, signal conditioning equipment, charge amplifiers and systems including engine vibration monitoring systems.

POWER CORRUPTS

In the USA the Federal Trade Commission has been holding public hearings to receive and evaluate new proposed standards for amplifiers.

Incredibly, the Electronic Industries Association supported by Sylvania, RCA, Magnavox (no relation to Aust. company) GE, Motorola, Admiral etc., propose in all seriousness to make power bandwidth disclosure optional, harmonic distortion figures to be taken at 1000 Hz only, and believe it or not — no mention to be made of distortion unless the figure is above 5%.

But at least all are agreed that the present system of adding the last three

digits of your phone number to the average power output and quoting the result as 'music power' must go. Ironically the new measurement is likely to be that mythical animal the 'rms Watt'.

TESTING TYRES WITH A LASER

The laser has been described as a solution looking for a problem. To some extent, this is also true of holography – three-dimensional laser photography.

Work in the CSIRO Division of Applied Physics, where lasers are already in use in precision length measurements, has suggested a new application for holography.

A hologram is an unusual type of photographic transparency in which all the information on an object is recorded as an interference pattern between light reflected from the object and an illuminating beam of coherent light from a laser. No lenses are required to make a hologram. The image, which is truly three-dimensional, is recovered from the hologram by illuminating it with the laser.

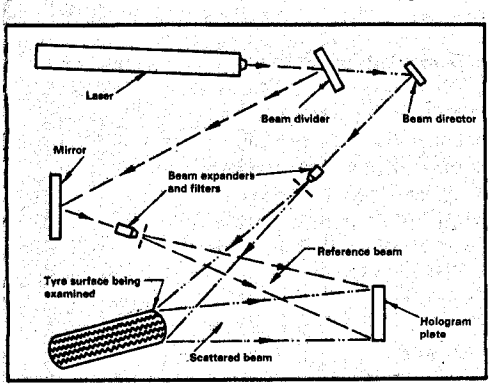
In ordinary photography, on the other hand, a two-dimensional image of an object is available on the negative in one step by focusing the light scattered from the object onto the film plane.

In the Division of Applied Physics, Mr. J.L. Goldberg and Mr K.M. O'Toole began applying interferometric methods to an ordinary car tyre during an experimental programme designed to produce holograms of objects with very low reflective properties.

They have found that changes of shape in the tyre at different inflation pressures can be determined using holography. It is believed that the variations can be related to defects in the structure of the tyre.

For the examination, the tyre is fitted to a standard rim and inflated to a normal working pressure, say 26 pounds per square inch. It is then set up with the laser, mirror, and glass photographic plate as shown in the accompanying diagram.

The plate is exposed to two light beams from the laser: one a direct or reference beam and the other con-



news digest

sisting of light scattered from the tyre surface toward the plate. Interference occurs between these light beams at the photographic emulsion plane and a small-scale pattern of interference fringes is recorded on it.

The tyre is then deflated by about 0.5 pound per square inch and a second exposure is made on the same plate. After developing and fixing, the plate is put back into its original holder and illuminated with the reference beam of light. When a viewer looks through the plate (the hologram), a three-dimensional image of the tyre can be seen, with the difference between the original and altered inflation shapes shown as a series of contour lines superimposed on the reconstructed image of the tyre. These contour lines or 'frozen fringes', as they are called, indicate variations of the order of a wavelength of light in the shape of the tyre. A highly irregular pattern could indicate a fault in the structure.

At this stage of development, it is thought that the holographic investigation technique is too expensive to be applied to the ordinary run of production tyres but it could probably be used without much further development for testing aircraft or motor racing tyres.

ELECTRONIC EQUIPMENT RELIABILITY

The Standards Association of Australia is seeking comment on a draft Australian standard for a reliability reliability programme for electronic equipment. This draft which is issued as as Doc. 1790, will form Part 3 of a comprehensive standard on reliability, covering Terminology (to be Part 1), Reliability concepts (to be Part 2), and this present part which provides guidelines for preparing uniform reliability programmes for use by manufacturers and sub-contractors of electronic equipment and sub-assemblies.

Copies of Doc. 1790 may be obtained without charge, from the various offices of the Standards Association in all capital cities and Newcastle.

Comment on the provisions of the draft is invited from persons or organizations experienced in the field of reliability and its assessment, or from interests outside the field of electronics, and should reach the head office of the Association, 80 Arthur Street, North Sydney, NSW 2060, or any branch office, not later than 31 October 1971.

SIMPLE STEPS TO RECORD PLAYING SUCCESS.

1. INVEST IN THE BEST TURNTABLE AVAILABLE. THORENS

Choose from the Model TD-125 or the TD-150 Mk. II. Then you can share the opinions of leading overseas reviewers: *"the best three-speed manual we've ever tested"* — ("High Fidelity"), *"wow and flutter were as low as we've ever measured"* — ("Stereo Review"), *"a favourite contender in the best turntable category"* — ("Audio"), *"it would be hard to imagine a unit that performs better"* — ("Electronics World").

Examine Thorens specifications closely and critically. The new Model TD-125 features: ● Transistor governed 16-pole synchronous motor ● ±2% speed control on all speeds ● Belt drive ● 7½ lb. 12" turntable ● Wow and flutter ±0.08% ● Rumble —68dB. ● Fine Swiss craftsmanship.

The lower priced Thorens TD-150 Mk. II offers: ● 16-pole synchronous motor ● Belt drive ● 7 lb. 12" diameter turntable ● Two speeds — 33⅓ and 45 rpm ● Wow and flutter ±0.09% ● Rumble —65 dB.

When you've purchased your Thorens turntable . . .

2. ADD AN ORTOFON M15 STEREO CARTRIDGE.

After many years research, Ortofon have designed a new stereo cartridge which maintains the proud traditions of the Ortofon name. Featuring new principles, the high performance standards which have made Ortofon world famous have been preserved in the new Series M15 and MF15. Over 80% of professional users such as the radio and television stations (and recording studios) specify Ortofon equipment.

BASIC SPECIFICATIONS:

Weight of cartridge: *5 grams.*
Frequency response: *20 Hz. to 10 kHz. ± 1 dB.*
20 Hz. to 20 kHz. ± 2 dB.
Recommended load: *47 k ohms.*
Channel separation at 1 kHz. *Greater than 30 dB.*

Having equipped yourself with a fine player and cartridge . . .

3. KEEP YOUR RECORDS CLEAN WITH WATTS EQUIPMENT.

Airborne dust and dirt are the greatest enemies of your records and cause untold amounts of noisy interference.

We recommend:

THE WATTS "DUST BUG" . . . which cleans the record, removing dust and static charges as the record plays. Surface noise is reduced considerably.

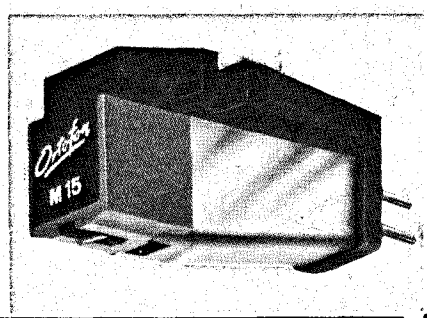
THE WATTS "DISC PREENER" . . . designed expressly for records which have not had previous anti-static treatment. The "Disc Preener" keeps new records like new.

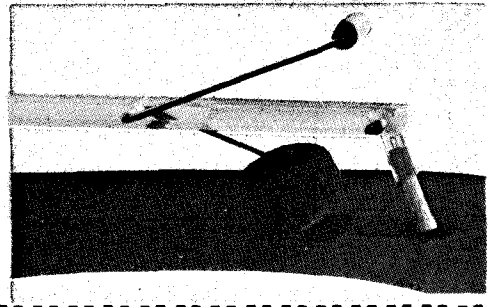
THE WATTS "MANUAL PARASTAT", Model Mk. IIA. . . . is a dual purpose record cleaner designed to maintain new records as new and to restore fidelity to older discs.

Ask for a copy of the Watts Guide to Record Cleanliness when you visit your record store.

**It's easy to follow the Three Steps to Success. Call at your nearest franchised Simon Gray dealer's showroom. He'll be delighted to tell you all about Thorens turntables, Ortofon stereo cartridges and Watts record cleaning equipment!*

SG TOW 3/71





Australian National Distributors:

Simon Gray Pty. Ltd.

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Simon Gray Pty. Ltd.,
28 Elizabeth Street,
Melbourne 3000.

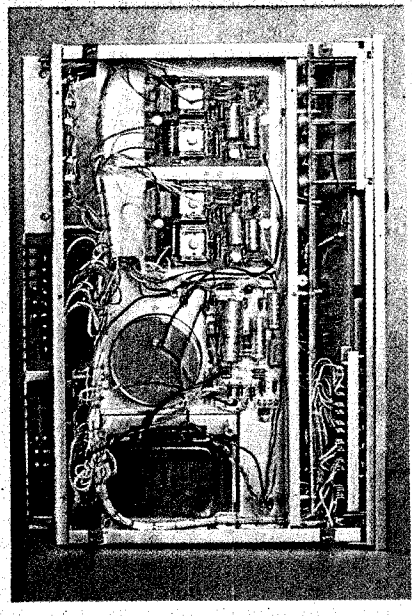
Please send me all the facts about: (a) Thorens turntables; (b) Ortofon cartridges; (c) Watts record cleaning equipment . . . and the name of my nearest franchised Simon Gray dealer.

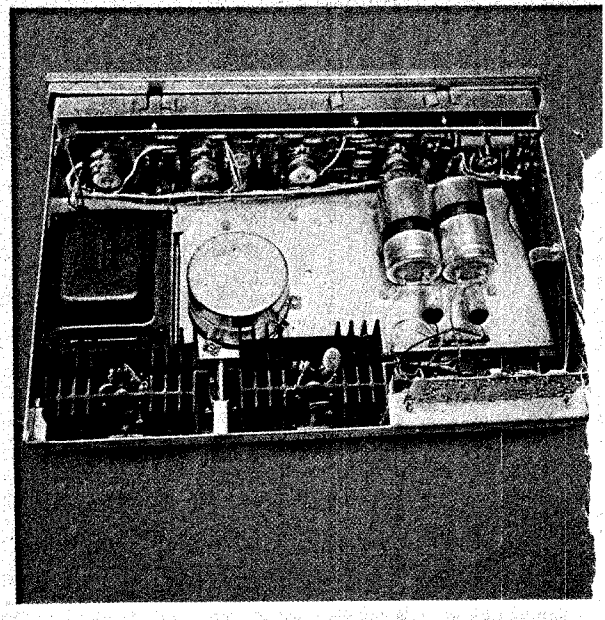
NAME.....

ADDRESS.....

.....**POSTCODE**.....

The amplifier took 40 hours to assemble — and worked first time.





ROLL YOUR OWN HI-FI

With no prior experience Jan Vernon put Heath's top-line amplifier and speaker kits together in 47 hours — and they worked first go. Here is our report.

AN American company once launched a new labour saving "add only water" cake mix. The product went over like a concrete zeppelin until market research revealed that housewives preferred the sense of creativity they got from cracking and adding an egg to the mixture. The company left out the egg powder and sales soared.

This type of research has convinced manufacturers that people buy "experiences" as much as material goods, and there is now a trend for goods to be increasingly designed to yield this type of "psychological extra" for the consumer.

This trend towards "experiences" instead of material goods will increase in the future.

The four day week is already becoming a fact in America. People are going to have more leisure time, and more time for family activities and hobbies.

They will be 'buying things to do', instead of just 'buying things'.

With all this in mind, we took a fresh look at the recent Heathkit catalogue.

Heathkit market a variety of products in kit form. Some of them are simple like the Heathkit Junior kits but their catalogue also lists some very sophisticated gear like stereo amplifiers and colour televisions. And their catalogue says "we know that you, regardless of your experience, can successfully build a kit at home with minimum effort and maximum savings and enjoyment".

As Heathkit products are now available in Australia we thought we'd test this claim. So we found a volunteer, to whom even a soldering iron was a new experience, and gave her $1116 worth of stereo amplifier and speakers to assemble (kits AS48 and AA15).

The results were mildly surprising. The speaker kit was not very difficult and Jan (our volunteer) had it assembled and operating within a few hours. But the amplifier was a most complicated piece of equipment. This took some weeks to build, but worked perfectly immediately it was switched on. Jan needed power assistance when a few metal screws proved too tight, but otherwise the step by step instructions and the fold out pictorials in the manual were all that was needed.

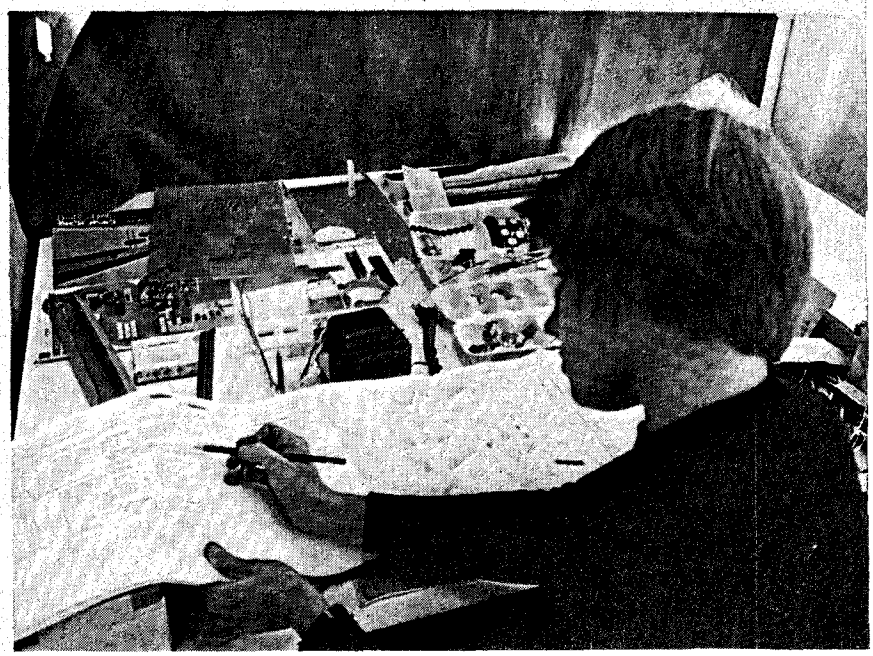
CONCISE INSTRUCTIONS

We were impressed by the thought that has gone into the writing of the construction manual.

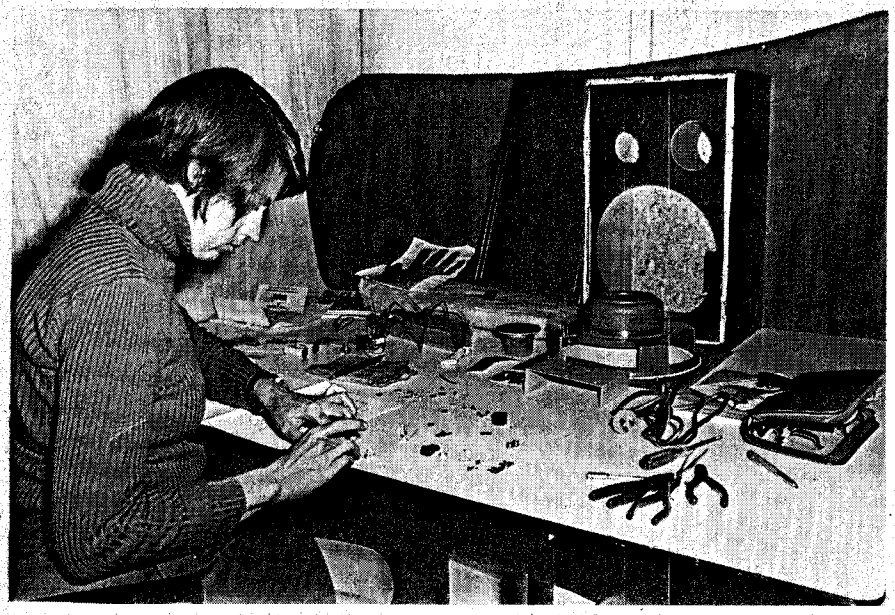
One circuit board is built at a time (starting with the most simple one) and parts are unpacked as required, so

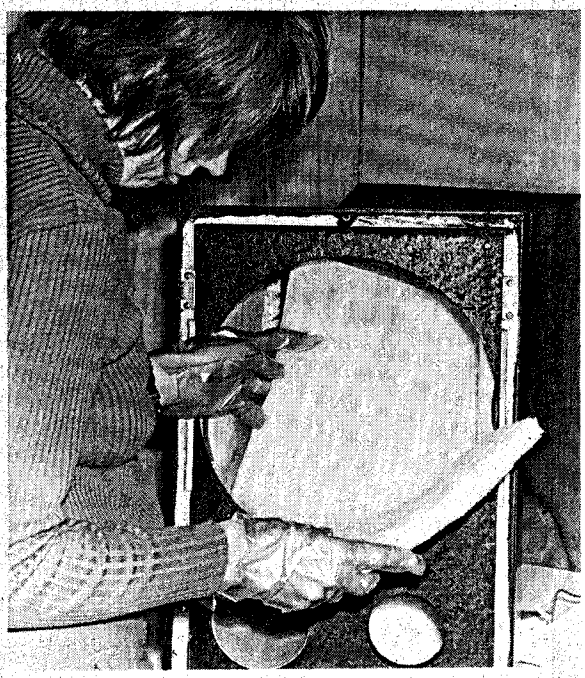
All the components were delivered in rugged cardboard cartons.

The components were checked against the inventory in the constructional manual.



ROLL YOUR OWN HI-FI





Jan commences assembly of the first of the two loudspeakers – note the massive 14" diameter JBL woofer.

Installing the glass fibre lining in one of the loudspeaker enclosures – even the gloves were supplied.

that the beginner isn't faced with a confusing jumble. Jan read the hints in the kit builders guide and used egg boxes to store the bits, with each compartment labelled as the bits were unpacked and identified. The instructions are understandable but not oversimplified. The Heath company seem to realise that the kit builder may not know anything about electronics but is otherwise an intelligent being. The writing is simple but not condescending.

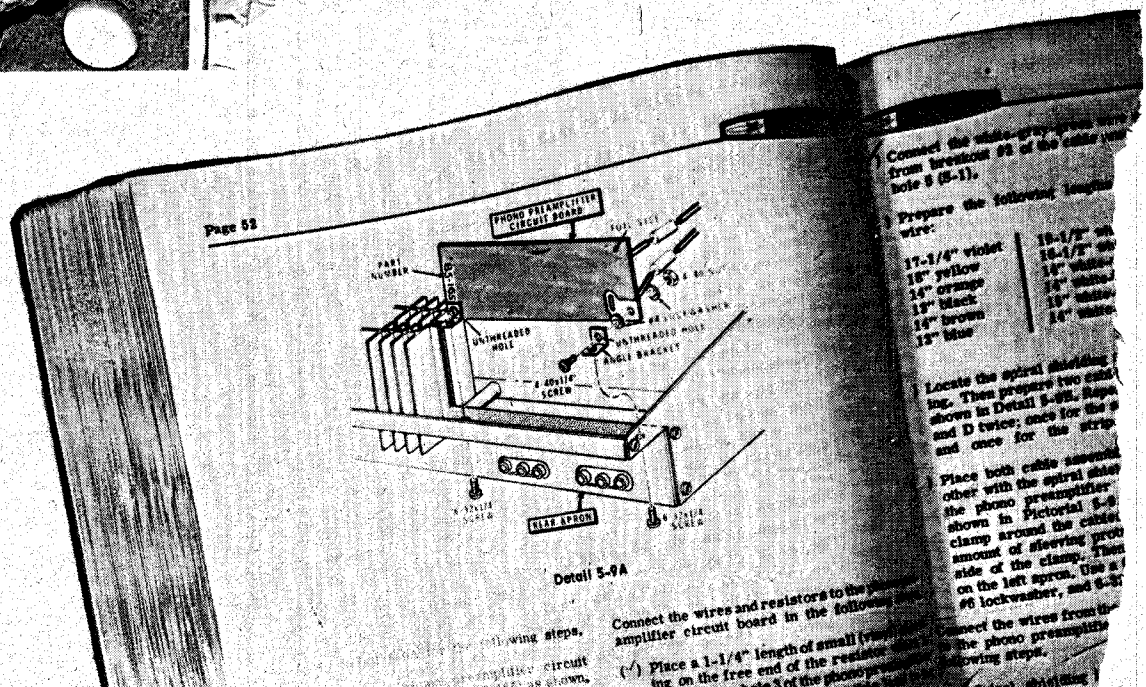
Construction is divided into logical sections. If you complete one section at a time then it's quite feasible to build the amplifier as a spare time project over several weeks. No worries about forgetting where you were when you stopped. Of course, you must have somewhere you can leave the project undisturbed between assembly sessions.

The two speakers and the amplifier took about 40 hours to build. Jan was working slowly, checking each step carefully. If you invest this much time in a job you naturally want to be pleased with the finished product. We liked the results. The speaker's cabinets are dark teak and sound good. The amplifier has an unusual double front panel. It is impressive in appearance.

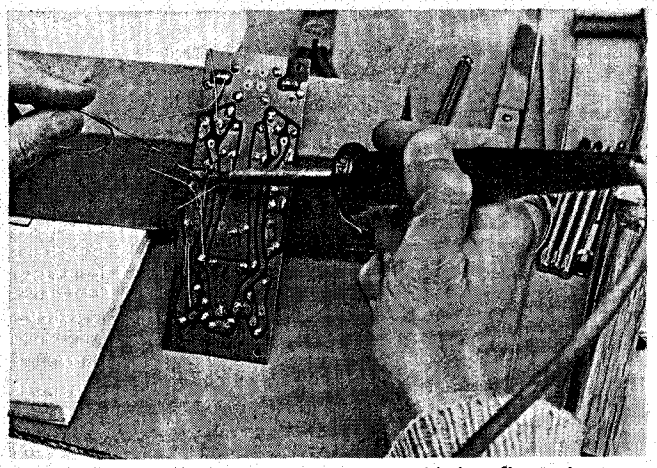
A FEW MINOR PROBLEMS

We have a few minor complaints.

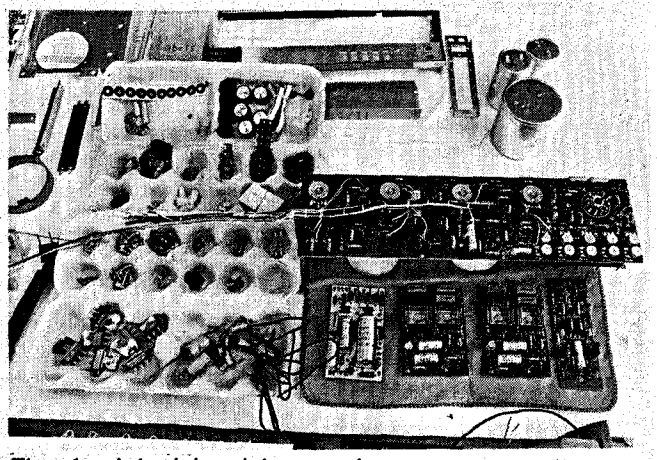
The kit was not specifically adapted for the Australian market, for example, a two wire power cord and plug were supplied and this would not be legally acceptable. Substituting a three wire system was complicated by there being no immediately logical place to connect the earth lead. However, we understand that the local agents will arrange to modify future kits in this respect – corrections will also have to be made to the relevant



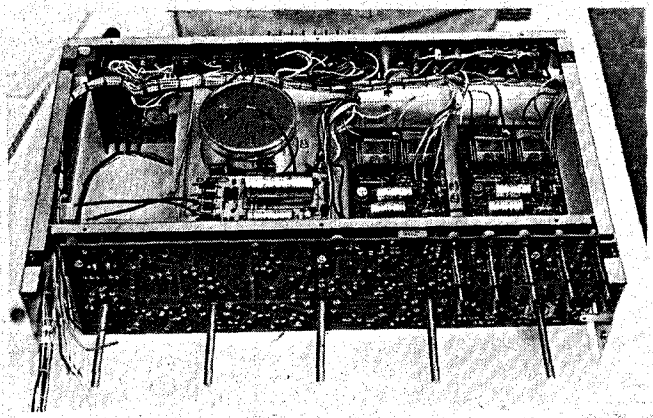
A couple of pages from the truly comprehensive amplifier construction manual.



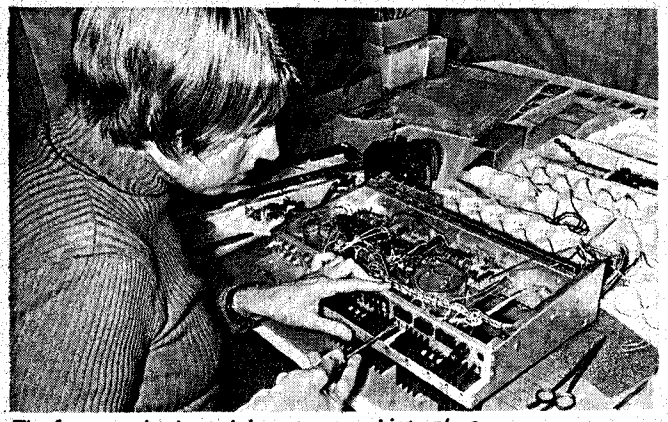
Most of the amplifier components are assembled on five main printed circuit boards. The position of each component is clearly marked on the reverse side of the boards.



The printed circuit boards have now been assembled and are ready to locate on the main amplifier chassis.



All the printed circuit boards are now installed — note the largest board which stretches right across the front of the unit. A wiring loom is supplied to ease inter-board connections



The four massive heat sinks are screwed into place.

part of the handbook.

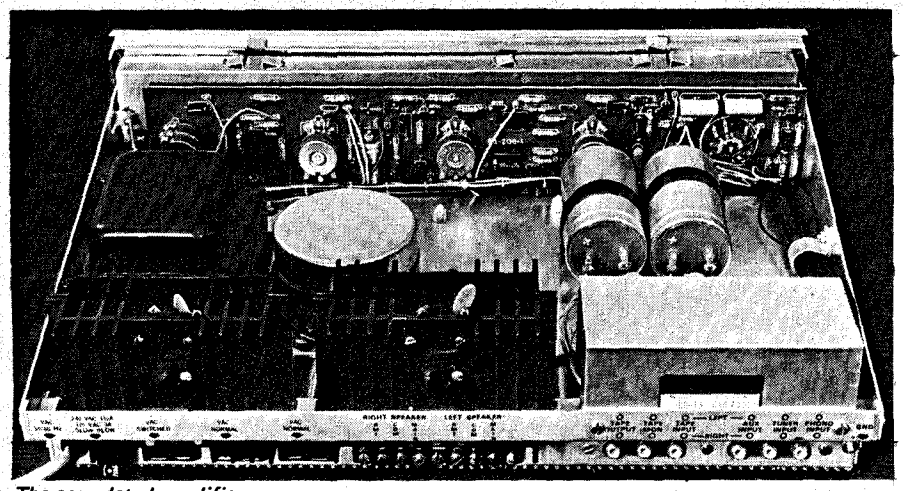
Other problems included a wrongly coloured wire, one which was actually brown whilst the manual insisted that it should be violet. One connecting lug was dirty and would not at first take solder.

To an electronics enthusiast or engineer these things are quite trivial, but they are confusing to a person with no electronic knowledge who must rely upon the parts and instructions being correct.

Jan had a couple of minor breakages, she broke a lead on one capacitor and tore one of the tracks on a printed circuit board. These again are minor problems if you have some electronics knowledge and access to spare parts, but disastrous for the complete novice.

The American company cope with these problems by offering a complete technical correspondence department — only a phone call or a letter away should a question arise — but how does the Australian kit builder manage?

We discussed this with the Australian Heathkit suppliers. They will replace any bits missing from the pack or broken on arrival. They are at present arranging agents who will do repairs to your finished product. If you buy an expensive kit, it seems wise to check that spare parts and assistance are available.



The completed amplifier.

CAN ANYONE BUILD ONE?

In general we think that the Heathkit claim is true. Anyone *can* build even the most complex of these projects providing they follow the instructions completely to the letter, and adopt a tidy and meticulous approach. But care, concentration and attention to detail is essential.

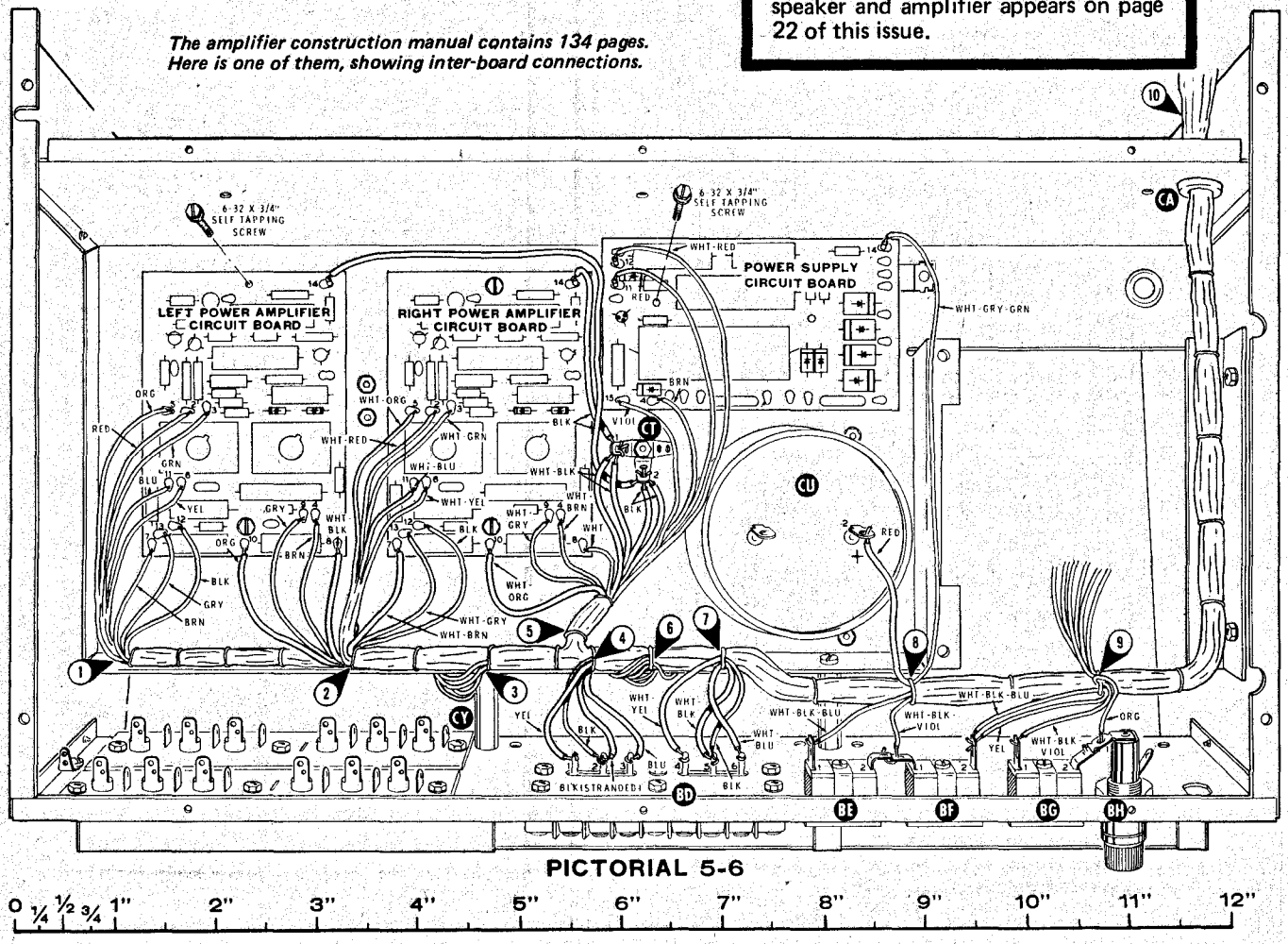
The amplifier that Jan assembled is one of Heath's more ambitious projects and if this can be built by a novice (as we proved it can) then it is clearly possible to build the many smaller items that come in kit form.

Some of the smaller kits which go together in a few hours might be more

ROLL YOUR OWN HI-FI

A completely independent test report on the performance of both this speaker and amplifier appears on page 22 of this issue.

The amplifier construction manual contains 134 pages. Here is one of them, showing inter-board connections.



PICTORIAL 5-6

fun for the learner. Putting the amplifier together without electronic knowledge seemed to us like assembling an adult jigsaw puzzle.

OUR CONCLUSIONS

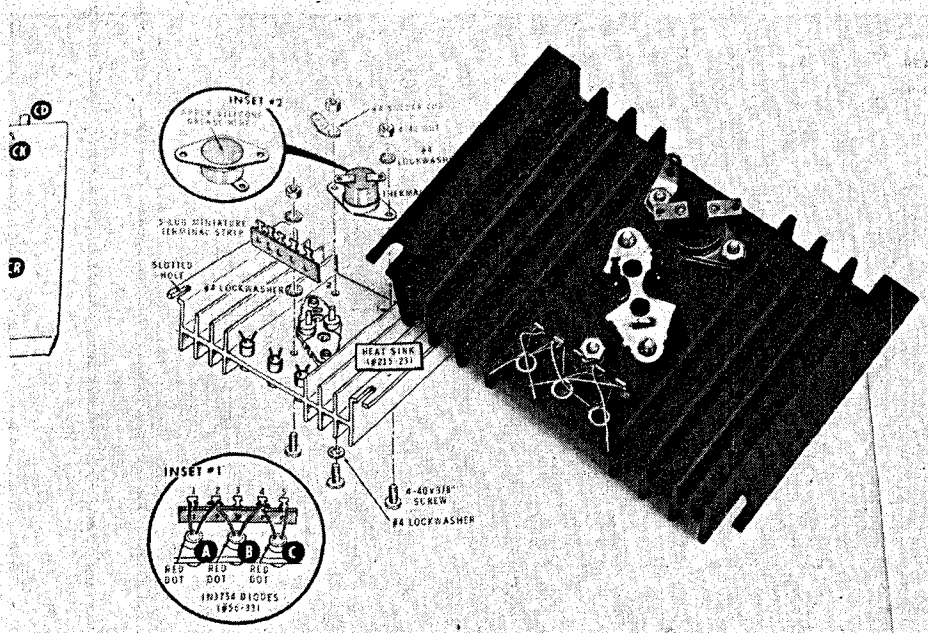
You save money by building your own speakers and amplifiers. But we aren't sure that this is the most important reason for buying a kit. After all you can get a very good amplifier for that much money.

We think the sense of accomplishment that you get from building the gear yourself is sufficient justification.

And if you've done your assembly properly the final result will be at least as well finished as many professionally built units.

But what happens after the kit is completed, does the builder relax and enjoy the results, or start looking for the next challenge?

Our volunteer kit builder, who previously had no interest in electronics, has stolen the Heath catalogue and spends hours gazing wistfully at a magnificent colour TV. ●



PICTORIAL 5-2

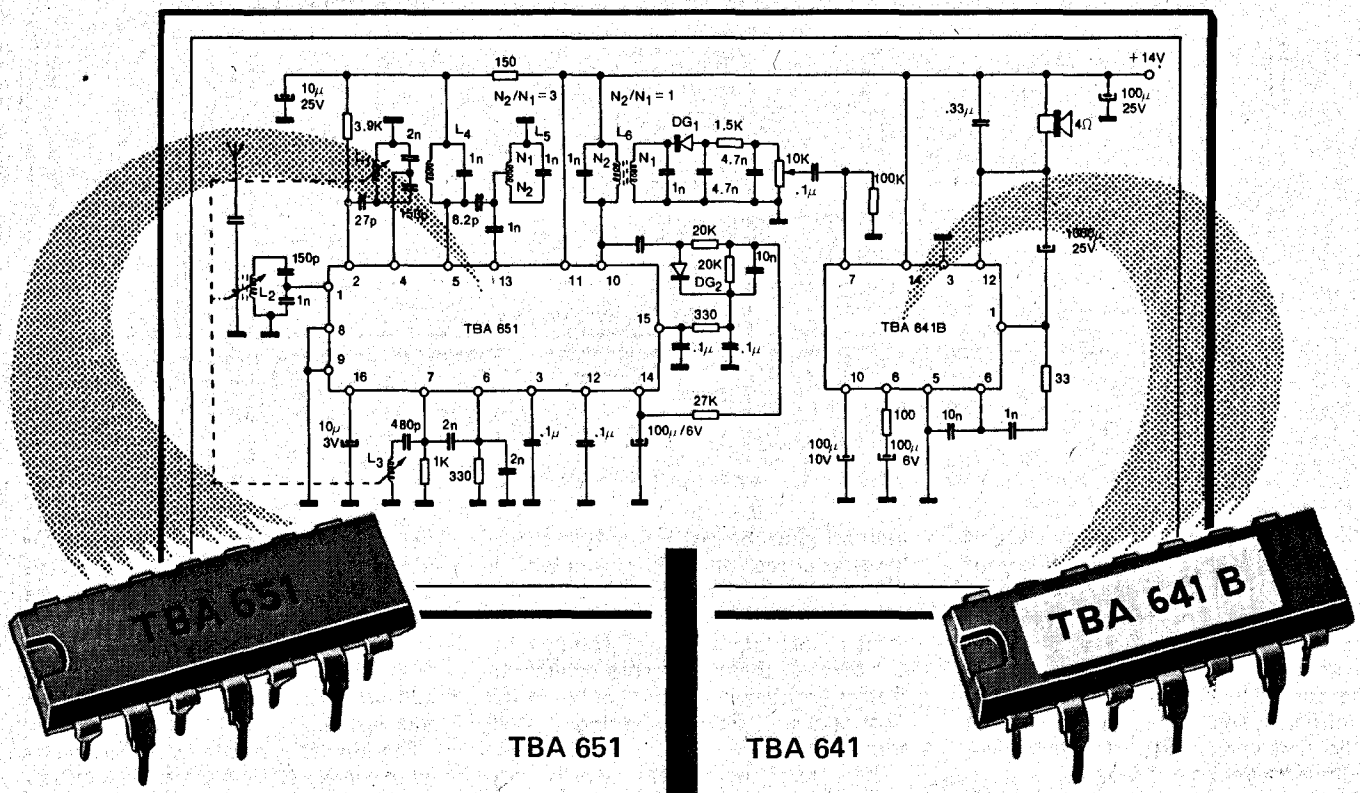
The partially completed heat sink assembly is shown here alongside the relevant instructions in the Heathkit manual.

SGS

low cost IC's FOR CONSUMER APPLICATIONS

APPLICATION: CAR RADIO RECEIVER

Diagram shows the circuit details for a high quality AM car radio receiver.



TBA 651

A linear integrated circuit that processes the whole high frequency signal in AM receivers. It is particularly intended for car radios and high quality radio receivers. The TBA 651 consists of five stages: RF amplifier, mixer, oscillator, IF amplifier and AGC control. It features high gain wide voltage supply range (4.8 to 18V), low noise and high sensitivity.

TBA 641

A monolithic integrated circuit primarily designed for use as a low frequency amplifier. The TBA 641 is particularly suitable for use in radio receivers, record players, tape recorders, intercom systems, sound film projectors and industrial applications. Variable or pre-set components external to the chip are not required.

OTHER *LOW COST* DEVICES AVAILABLE FOR —

■ RADIOS ■ RECORD PLAYERS ■ CAR RADIOS ■ HI-FI PRE-AMPLIFIERS ■ POWER SUPPLIES

Full range available from:

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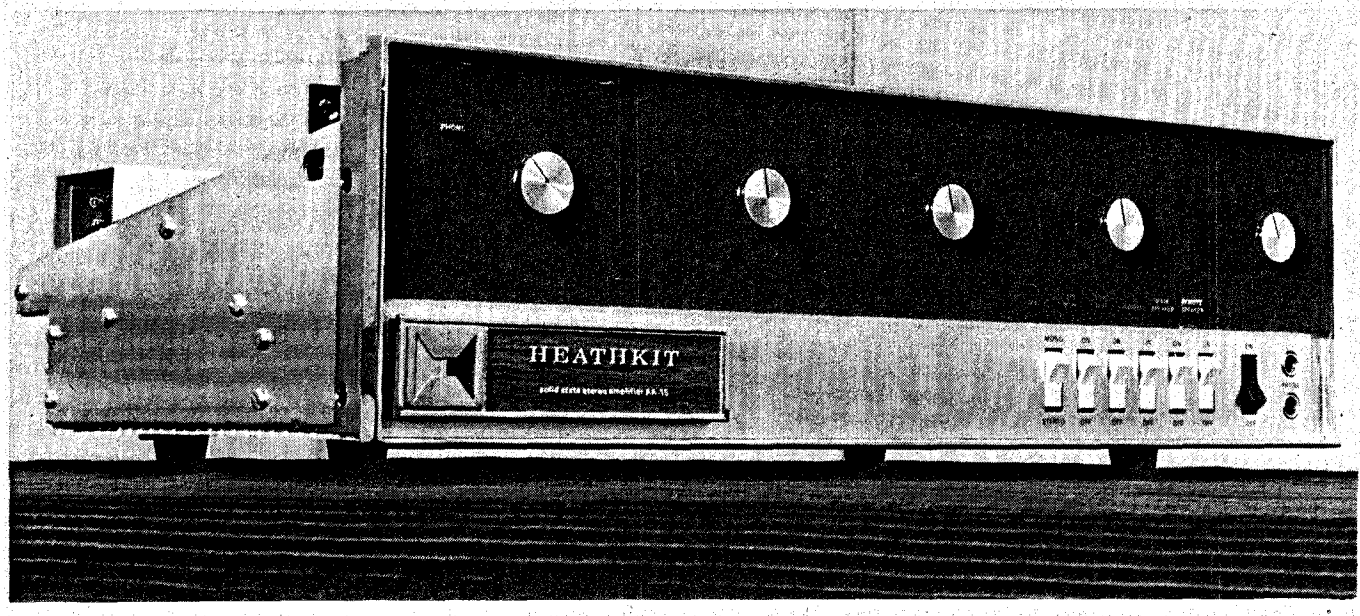
WF3071

HOME BUILT HI-FI

Electronics Today's acoustical consultants test our home-assembled Heathkit AA15 amplifier and AS 48 speakers



The concept of buying a kit of parts and putting together your own electronic equipment goes back to the days when just about everything was made that way because amateurs were almost the only people interested in making radios and amplifiers. My father built his first radio that way nearly fifty years ago, and maybe your's did too.

Realising that here was a commercial market, quite a number of American firms started manufacturing precision components for those early enterprising amateurs. Today, fifty years later, the trend has changed and those manufacturers still left in this field market complete kits which make the old parts manufacturers look archaic. The kit set of today, totally unlike that of old, comes complete with every nut, bolt and part, together with a handbook that by any standards can only be described as superb.

The Heathkit company of America is one of the largest firms producing this type of equipment and their products cover the range from experimental kits to semi-professional test equipment and radio communications gear.

But because of high duty and marketing problems, most Australians have never seen these kits. And whilst the distribution has changed as a result of Heathkit being acquired by the great Schlumberger group of companies, there are still economic factors which will preclude most Australians from buying this equipment.

The Heathkit system which we received for testing is rather unusual by any standards.

Firstly, because it consists of a true twin 50 watt (average power) amplifier, together with a pair of speakers enclosures to match, and secondly, because the entire system was assembled and soldered together by a woman who had no experience whatever in this field, and had only the instructions supplied to guide her. The system worked when it was switched on, (which makes me a little envious) and was then sent direct to us for testing.

Once unpacked and placed on the test bench, we were confronted with a front panel which had a row of five unmarked knobs, five unmarked white on/off rocker switches and one unmarked black on/off switch. A sixth white rocker switch was marked mono or stereo. The question now was which switch should be operated first. Our choice of the black rocker switch proved to be fortuitous as it was the main power switch, which then illuminated the black panel behind the five unmarked knobs, thereby indicating the function of each knob and switch.

The functions of the five black knobs (with silver centres) were from left to right:

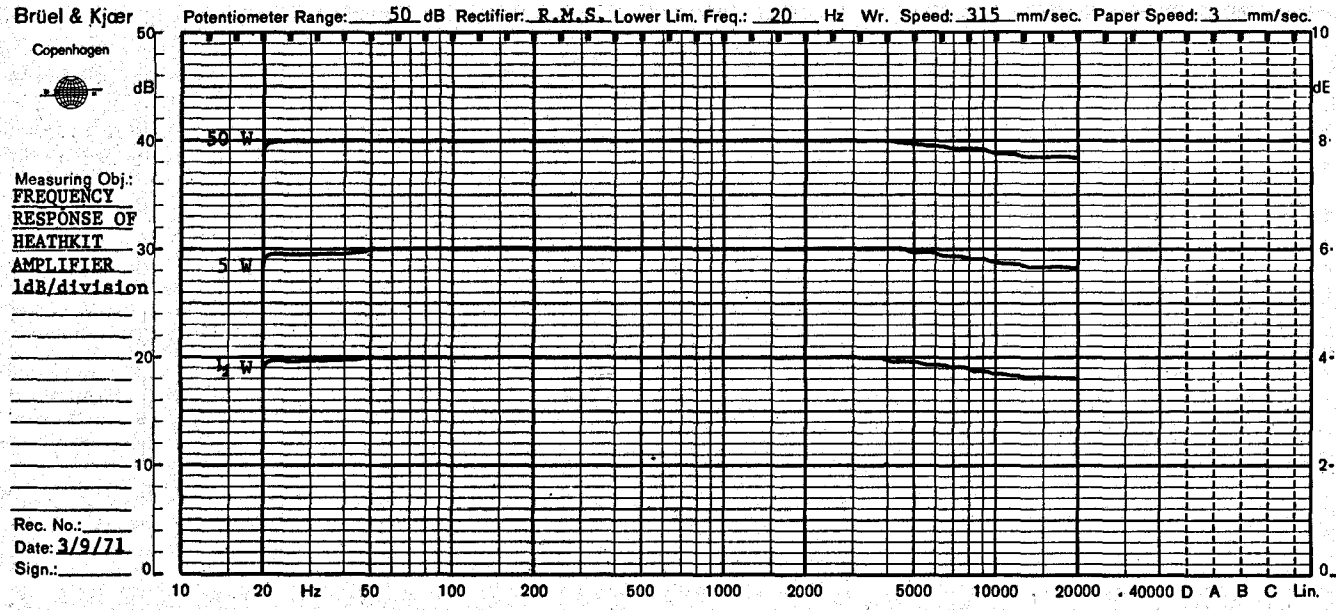
1. Function selector with phono, tuner, tape and auxiliary positions
2. Treble control
3. Bass control
4. Balance control
5. Volume control

The six white rocker switches which were located in the bottom left hand segment of the front panel provided the following controls . . . from left to right:

1. Mono or stereo mode
2. Tape monitor on/off
3. Flat tone on/off
4. Loudness on/off
5. Main speaker on/off
6. Remote speaker on/off

A black power on/off switch and a headphone socket were located in the bottom right hand corner.

The bottom left hand corner contained a large Heathkit emblem



that hinged down to expose a number of trimmer pots, used for balancing the various inputs. A label on the back of the emblem detailed the respective inputs associated with each pot.

Overall the appearance of the front panel with the dark green perspex screen (behind the black knobs) and a recessed aluminium panel across the bottom (containing the emblem and rocker switches) was conservative when compared with the more common brushed aluminium escutcheons seen on many modern day amplifiers.

The aluminium chassis and printed circuit board were extremely well produced and appeared to have fitted together without any modification at all, a rare case with many construction kits. The chassis was designed for flush mounting in a panel.

All input and output sockets were located on an aluminium panel across the rear of the chassis. A set of six pairs of R.C.A. sockets located at the right hand end of this panel provided from right to left, phono, tuner, auxiliary, tape input, tape monitor and tape output facilities respectively (when viewed from the rear). The centre of the back panel had two terminal strips, one for the right channel speakers (main and remote) and one for the left channel speakers.

Particular care and attention has been given by the designer to provide circuitry using premium quality

electronics TODAY
product test

components, and free from obvious vices.

The output transistors are particularly well mounted on individual heat sinks and the inclusion of high temperature alarm with visual indication on the front panel is an unusual and practical feature.

The fact that the amplifier worked first go, was no doubt attributable to the ability of the woman who constructed the unit and the comprehensive construction manual supplied with the kit.

Considerable attention had been given to the presentation of the manual. This included extensive diagrams and photos to illustrate step by step the construction and assembly and devoted many pages to operation and adjustment of the unit.

Indicative of the thought put into the manual was the high gloss paper used to provide exceptional definition of all circuitry and plates. In fact the manual had in the region of 125 pages plus circuit diagrams.

MEASURED PERFORMANCE

Before taking test measurements we adjusted the input trimmer potentiometers to provide balanced outputs as it had not been possible to do this previously when the unit was constructed. While making these adjustments a few minor faults were found, the worst of these being the right auxilliary trimmer pot which was internally shorted and thus provided no adjustment whatsoever. It was also noted that the right panel top input had a very low sensitivity. The initial sensitivities with all trimmer pots set to maximum gain were as detailed in "Measured Performance".

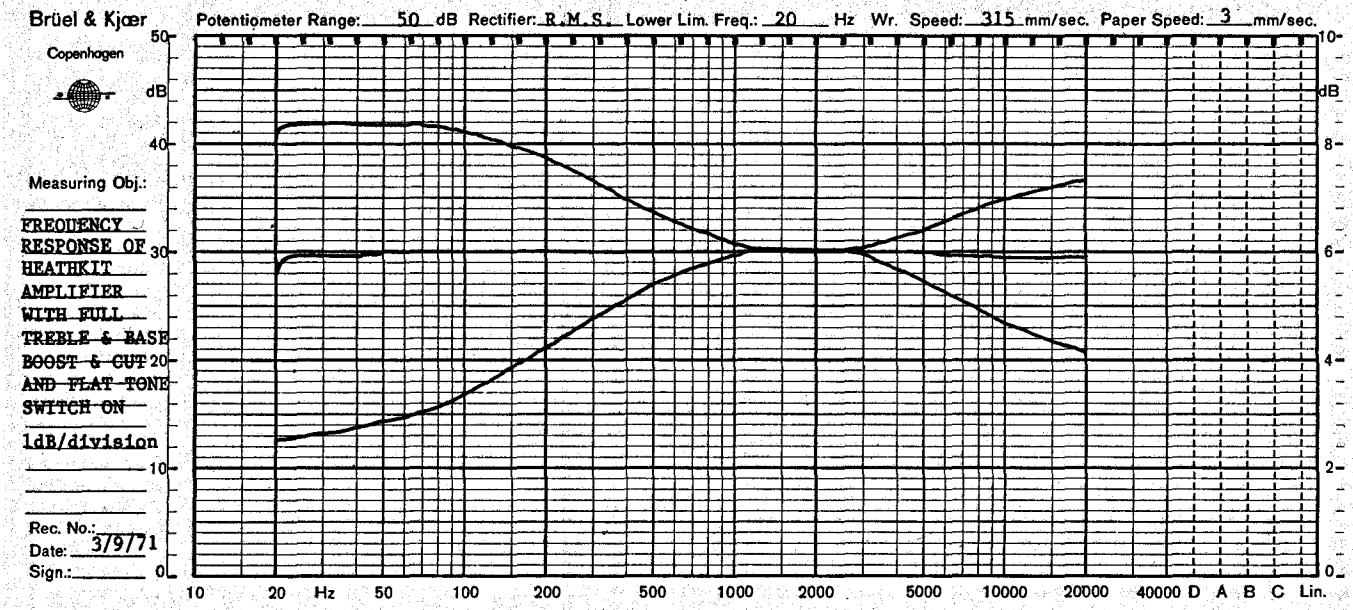
The frequency response of the amplifier was flat from 25 Hz to 5 kHz and dropped approximately 1.4 dB at 20 kHz when delivering 50 watts into a 8 ohm resistive load.

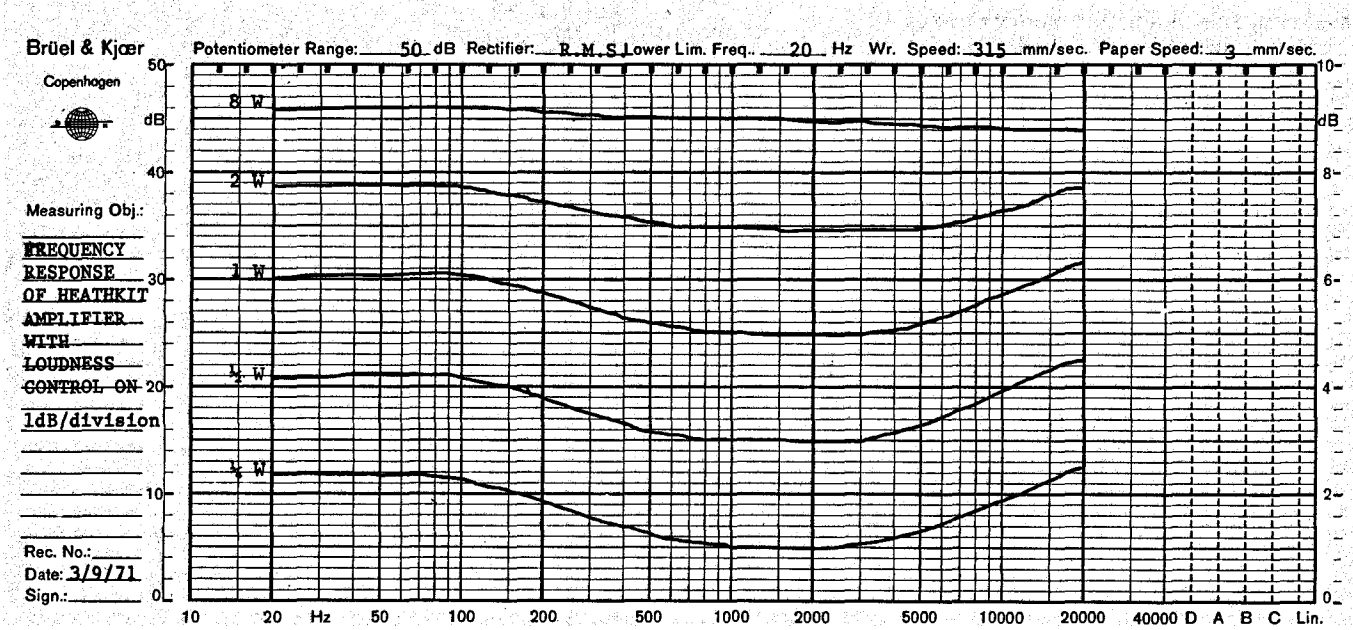
The loudness control, when switched on, became effective below 8 watts output and provided a 7 dB boost at 20 kHz and 6.5 dB boost at 70 Hz with a quarter watt output. Ideally the boost at 70 Hz, with the loudness control on, should be approximately 13 dB to provide reasonable balance between high frequencies and low frequencies at low listening levels.

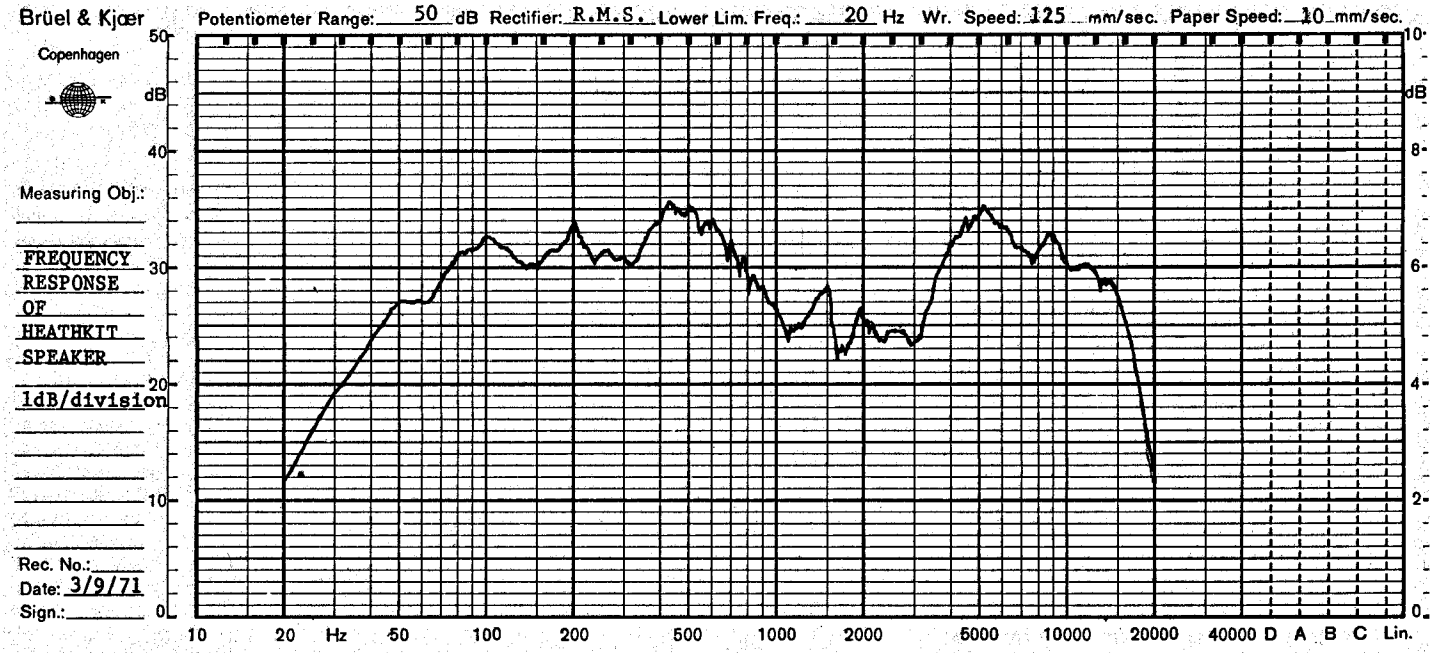
The balance control provided in excess of 20 dB attenuation in either channel. This is more than adequate for most balance requirements. Harmonic distortion, which was measured with both channels equally driven, was higher than the levels quoted in the manufacturer's specifications, particularly at the high frequency end of the spectrum.

THE SPEAKERS

The speaker kits also came with a complete instructional manual of comparable quality to the amplifier manual.







The components consisted of a 14" diameter JBL woofer and a 2½" diameter JBL tweeter, together with full LC crossover networks. All were housed in a vented enclosure finished in dark polished walnut veneer.

The frequency response of the speakers was reasonable with a slight drop in the mid-range around the cross-over frequency. Generally a mid-range speaker is used to counteract this drop-out, and whilst increasing the cost, had one been included it would have made the kit as good as most JBL professional speaker systems.

The Heathkit speakers were compared, subjectively, against our own JBL control room monitors (which have a known response). The loss of presence could be heard, and whilst it was not disastrous, when considering the high cost of Heathkit speakers ($391 each), it would be enough to discourage us.

We have always made it clear that we believe that the speaker is the most critical element in a hi-fi system. When it is considered that a pair of JBL Control Room Monitors and a twin 80 Watt Pioneer SA 1000 amplifier can be bought for $1185 against the $1116 of the unassembled Heathkit, we feel you have to be awfully keen on assembling a kit.

The performance of the Heathkit products that we tested is good by kit standards, but (at least in Australia) we doubt if they can be compared in either price or performance with other fully assembled systems. ●

HEATHKIT AMPLIFIER MODEL AA-15 SERIES NO: 046-4358X

MEASURED PERFORMANCE

Frequency response at 50 watts average, both channels driven
20 to 20 kHz — 1.5 dB reference 1 kHz

Total harmonic distortion (with both channels) driven

Power output	100 Hz	1 kHz	10 kHz
50 W per channel	.56%	.6%	2.5%
10 W " "	.31%	.35%	1.4%
5 W " "	.25%	.25%	1%

Typical hum and noise level
Better than -70 dB (reference 50 Watts)

Bass control:	+12
	-15 at 70 Hz
Treble control:	+7
	—9 at 20kHz
Loudness control:	7 dB boost at 20 kHz
(at ¼ watt output)	6.5 dB at 70 Hz

Tape Output levels for recommended Input levels

Input Function		Output level prior to balancing (mV)	Output level after balance (mV)	Input Level used (mV)
Phono	Right Chan.	158	158	2.2
	Left Chann.	176	158	2.2
Tuner	Right Chan.	120	120	200
	Left Chann.	162	120	200
Auxiliary	Right Chan.	185	No Adjustment	200
	Left Chann.	165		200
Tape	Right Chan.	87	87	200
	Left Chann.	162	87	200

Speakers

Frequency Response: Refer to level recording.
Power handling capacity greater than 50 watts between 100 Hz and 3 kHz

Price $1116

POWER SUPPLIES

This series of articles by B. Doherty outlines the operation, performance, limitations and design aspects of the modern dc power supply.

PART 2

THE first part of this series published last month described the way in which ac power can be transformed to a higher or lower voltage, and, by various forms of rectification, converted into dc.

But, as was shown, the output voltage from an unregulated supply may vary considerably with changes in input voltage, load current and ambient temperature.

This can be overcome by comparing the output voltage against a 'reference voltage' (that will remain constant despite external variations) and correcting accordingly.

The zener diode may be used as voltage reference source for just this purpose. It is simply a diode manufactured in such a way that it has the unique ability of maintaining a very high reverse resistance, until, at a certain critical voltage, the dynamic resistance falls to a very small value. In this region an essentially constant voltage will be maintained over a wide range of currents. This is shown graphically in Fig. 27.

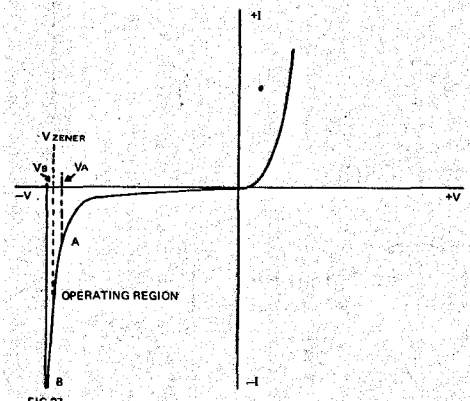


FIG 27

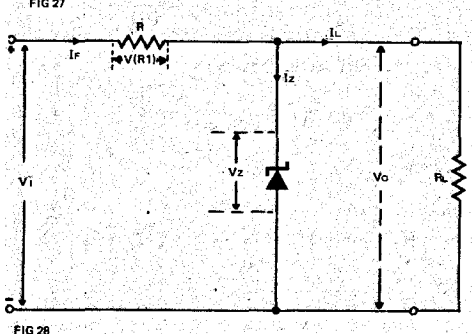
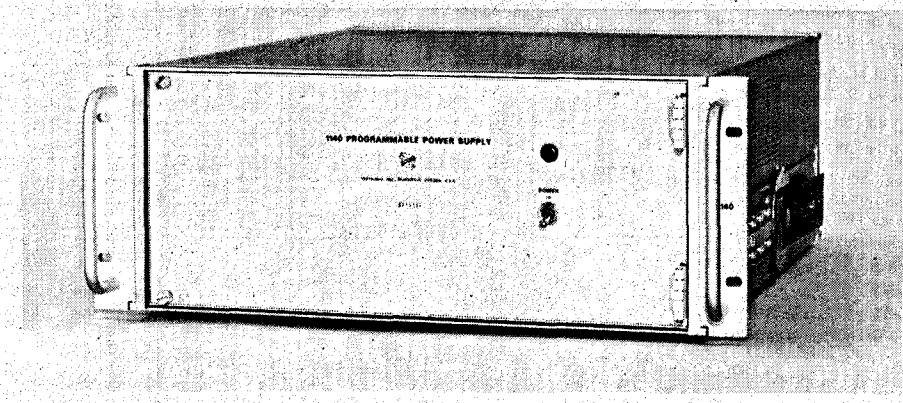


FIG 28



This unit from Tektronix contains three 40 volt supplies, one 100 volt supply, and one current supply. The power unit can be externally programmed.

Fig. 28 shows a zener diode used to produce a constant voltage despite varying load current and supply voltage. As these vary, the zener shunt element draws more or less current. The nett result is a substantially constant output voltage across R_L.

The series resistor R is selected so that the minimum current passing through the zener, lies beyond the knee of the curve shown in Fig. 27, but at the same time ensuring that the zener diode does not exceed its maximum specified power rating (which is at a maximum at zero load).

The design proceedure for the simple shunt regulator shown in Fig. 28 is:—

1. Specify maximum and minimum load current (I_L), say 10 mA and 0mA.
2. Specify the maximum supply voltage V_i that is likely to occur (say, 12 volts) but ensure that the minimum supply voltage will always be approximately 1.5 volts higher than the breakdown voltage of the zener to be used.
3. Thus at any time $V_i = V_z + V_{(R1)}$, where V_z is the breakdown voltage of the zener, $V_{(R1)}$ is the voltage across R_1. And $I_z = I_z$ (min) + I_L, where I_L is the maximum load current required.

Assume that the required output voltage, and hence the zener voltage is 6.5 volts, and the specified minimum zener current is (I_z min) is 100 micro-amps.

Then the maximum I_z is 100 micro-amps + 10 mA which is 10.1 mA.

Thus the series resistor R1 must conduct 10.1 mA at the lowest input supply voltage: and so allowing 1.5 volts minimum drop across R1 (in other words $V_i - V_z$) then

$$R1 = \frac{1.5}{10.1 \times 10^{-3}}$$

$$= 148.5 \text{ ohms}$$

The value of R1 is thus 148.5 ohms, and the nearest preferred value to this is 150 ohms.

At the maximum supply voltage (12 volts) the voltage drop across R1 is $I_z R1$.

$$I_Z = \frac{(12 - 6.5)}{150} \text{ mA.}$$

$$= 36.7 \text{ mA.}$$

And this is the maximum current that will flow through the zener at any time, i.e., maximum input voltage and

zero external load.

The power dissipated by the zener under these conditions is

$$Pd = I_Z V_Z$$
$$= 6.5 \times 36mA$$
$$= 234\ mW.$$

This power dissipation is within the capabilities of most small zener diodes — which are rated at 400 mW min.

It should be noted that whilst the zener voltage should be equal to the desired dc output voltage, there is always a small tolerance on the nominal value of the voltage (typically ± 5%), and selection may be necessary in critical applications.

SHUNT REGULATORS

The regulation and power handling capability of a zener diode may be increased by using it as a voltage reference element in an amplifier circuit.

The simplest of these, the shunt regulator, is shown in Fig. 29.

Fig. 29 illustrates the way in which

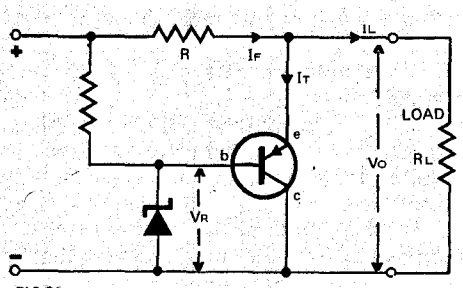


FIG 29

an amplifier is combined with a zener diode.

In this circuit arrangement the zener voltage is made nearly equal to the desired output voltage, and holds the base of the transistor fixed at voltage V_R. If V_o decreases, the voltage between the emitter and base of the transistor will decrease by the same amount, so reducing the emitter current I_T, and with it I_f ($I_f = I_T + I_L$), so tending to restore V_o by decreasing the voltage drop across R. All other variations are similarly accommodated.

The two main advantages of this type of circuit are that the power rating of a transistor is usually greater than that of a zener diode, and this allows a lower value of R to be used, thus improving the regulation of the circuit and secondly, the amplification introduced by the transistor increases the sensitivity of the circuit to much smaller changes in output voltage.

The shunt regulator is inherently short circuit proof, and because of this it is often used for simple power supplies intended for schools, and experimental use. The circuit is however, basically inefficient, and because of this, the series type of regulator is more commonly used.

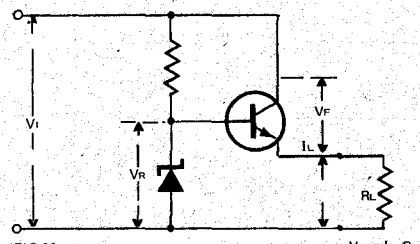


FIG 30 Vo = IL RL

SERIES REGULATORS

The basic series regulator circuit is shown in Fig. 30.

The voltage at the base of the transistor is held at a constant voltage, V_R, by the Zener diode. If the output voltage rises, a greater current may pass through the transistor (since $V_o = I_L R_L$). But this increase in V_o decreases the voltage between emitter and base of the transistor, so reducing the current which the transistor may pass. And since $V_f = V_i - I_L R_L$, increasing the collector to emitter voltage (V_f) reduces V_o back towards its previous value.

The main disadvantage of this circuit is that the regulating transistor is in series with the output, and because of this it must be capable of carrying the full load current; if a short circuit load is applied, the full dc voltage appears across the transistor.

REGULATORS — a more general view

Both the series and shunt transistor regulators described above measure the difference between a fixed reference voltage and the output voltage, and use this voltage difference to control the regulator. In other words the regulator compares output voltage to reference voltage and makes an adjustment in accordance with this difference.

All regulators use a comparator circuit, and this introduces the problem of providing a fixed reference suitable for both a non-variable voltage source and a variable voltage source, (which must of course have an adjustable reference).

A fixed standard voltage can be provided by using either a standard cell as a well defined known voltage; or a zener diode which, with proper circuitry, gives a fixed (but not necessarily accurately known) voltage.

The standard cell voltage reference will only remain accurate if negligible current, or at least a constant current is drawn from it, so that the internal voltage drop is constant. The main drawback of the standard cell is that it "goes flat", but if treated with due respect, it offers a very accurate reference, and in critical applications this disadvantage may be tolerable.

Loading on the cell can be prevented by using a buffer amplifier. The type of amplifier used will take the difference between two inputs and give an output proportional to this difference.

A simple buffer amplifier is shown in Fig. 31.

Terminal 1 is at zero potential and terminal 2 is at a potential $V_r - E_r$. The load current is supplied by the amplifier, not by the standard cell, which now serves only to maintain a fixed voltage difference across the amplifier. If the input resistance of the amplifier is high, the current drawn through the cell will be small. Ideally, the input resistance of the amplifier will be infinite, so that no current is drawn from the standard cell. This circuit allows a substantial current flow at the reference terminals without loading the standard cell.

The inconvenience of periodic cell replacement may be avoided by using a zener diode, although this results in a small sacrifice in accuracy.

A zener diode circuit can however be made extremely stable by maintaining a constant current in the zener (there being only one voltage on the characteristic curve corresponding to any one particular current). In order to maintain a constant current, the zener diode is connected across the terminals of a constant current generator as shown in Fig. 32.

In this circuit, (Fig. 32), terminal 1 is at zero potential and terminal 2 is at a potential Vr — Ez. The load current is supplied by the amplifier not by the zener diode, which now serves only to maintain a fixed voltage difference across the amplifier. If the input

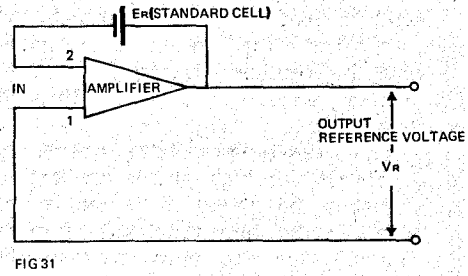


FIG 31

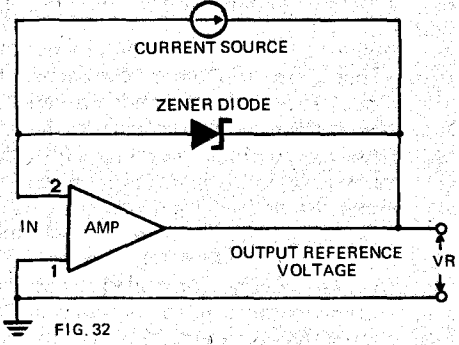


FIG. 32

resistance of the amplifier is high, or at least constant, the current through the zener diode will be a constant value at all output load conditions.

An adjustable reference is provided by circuits of the basic type shown in Fig. 33.

Either a potentiometer or a stepped switch may be used to vary the potential input to the amplifier, and hence its output. There are many refinements to this circuit which can be readily seen in specific regulator circuits.

Since the regulator tends to counter any fluctuation in output voltage it will tend to reduce the effect of the ac component of the dc, thus assisting the filter circuit.

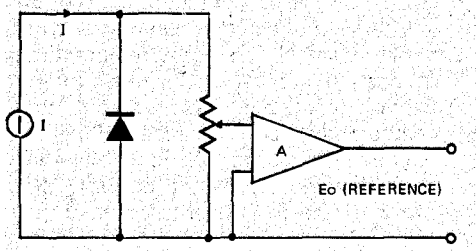


FIG 33

CONTROL OF POWER DISSIPATION AND VOLTAGE RANGING.

The regulator circuit must be capable of dissipating a good deal of power. For a shunt regulator with no load the full voltage is across the regulator, and for a fully loaded series regulator, the full current must flow through the series transistor. The power dissipated by the regulator is the product of voltage across it and current through it.

The series type regulator is generally preferred for high power application because the power dissipated is less than for the shunt type, and it is more suitable for use with pre-regulator circuits.

The pre-regulator circuit adjusts the output voltage of the transformer to a few volts above the desired dc output voltage, so that there need only be a low voltage across the series transistor, hence reducing its power dissipation.

There are two basic approaches to this. The first is to provide a variable transformer output voltage by having taps at various voltages on the secondary with a rotary switch to select the desired tap (a refinement of this being the continuously variable variac type transformer). The second is to use Silicon Controlled Rectifiers (SCRs) in the type of bridge rectifier circuit shown in Fig. 34, the output of

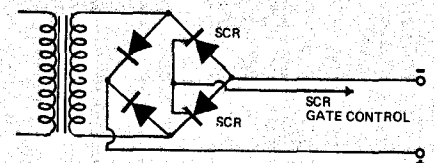


FIG 34

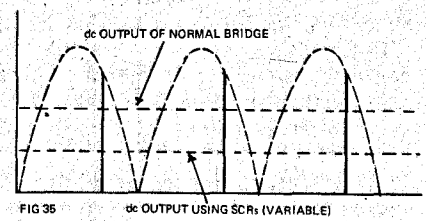


FIG 35

which is shown graphically in Fig. 35.

PROTECTION

The protection of a power supply involves protection of each of the main elements, (the transformer, the rectifier, and the regulator) from overpower, overcurrent, and overvoltage in both steady and transient form.

The simplest form of protection is the fuse, or in its more elaborate variant, the circuit breaker. The fuse uses the heat produced by the overload current to melt a fine piece of wire, which, on melting, produces a gap in the wire over which an arc will be struck until further melting increases the gap beyond the length that the arc can sustain. The break in the circuit is then complete.

The circuit breaker uses the overcurrent to operate an electromagnet which separates contacts to break the circuit. There is an arc drawn at the initial opening of the contacts, but this breaks before the opening is complete.

Both fuse and circuit breaker are quite adequate for protection of the transformer, but unless they are of special construction, have severe limitations if used for semi-conductor protection.

The semi-conductor material is only a fine chip, which will heat very quickly to its maximum allowable temperature (which is quite low). The transformer on the other hand heats quite slowly because of the large masses of material used in its construction.

A conventional fuse will not break the flow of current immediately. It must first be heated to its melting point. Typically, this will take about one second at twice normal current, 100 milliseconds at four times normal current and 10 milliseconds at 10 times normal current. A silicon diode will be destroyed, typically, after half a second at twice normal current, after 30 milliseconds at four times normal current, and after five milliseconds at 10 times normal current. Thus if the diode and fuse are rated for the same current the diode will protect the fuse.

A similar problem arises with a circuit breaker, which, because of its inductance, delays the current build up and requires a finite operating time for contact movement.

The conventional protective devices are, therefore, limited in their application, unless they are rated well below the diode current maximum. This, in fact, is the usual solution applied to "built-in" power supplies which have only to carry the load they are intended for.

A safe formula that will ensure that the diode is adequately protected by the fuse is

Diode max. current = 4/5 X short circuit current.

With present-day diodes this substantial over-rating can be achieved quite easily in most cases, and at moderate cost.

Another method is to use special types of fuse and circuit breaker that act much more rapidly than the conventional type, and are therefore, suitable for protection of semi-conductors. But care should be taken when considering the use of fast-action fuses, because of the possibility of someone inadvertently replacing them with conventional fuses.

In mose cases using over-rated semi-conductors is better.

Clearly it will be desirable to limit the short circuit current to as low a value as possible. With a normal transformer the internal resistance of the transformer and diodes is the only limit on the short circuit current. But as we have already seen the higher the internal resistance the more difficult the problem of regulation, so there is an obvious need to compromise and it is usually towards a lower resistance to improve regulation and reduce transformer heating in regular service.

It is here that the self-regulating (saturating core) transformer possesses a marked advantage.

The currents in primary and secondary of the transformer are related so that if the secondary current increases, so does the primary current required to maintain the secondary current, and as the current increase so does the flux, which is the only link between primary and secondary. In a

conventional transformer this is so up to the full short circuit current, so the primary continues to supply the flux to support a high secondary current. But the self-regulating transformer saturates, i.e., the flux does not increase after a certain level, so there is no increased flux to support an increase in secondary current, thus the maximum current which can be supplied by the secondary is limited by the saturation of the transformer core.

The circuit is, therefore, self-limiting and theoretically has no need of any other protection provided that the rectifier and regulator can carry the maximum current which the secondary will deliver.

The simpler type protection described above is not always adequate and there are a range of electronic protective circuits which give better protection.

OVERCURRENT CONTROL

The basic method of current control is to insert a low value resistor in series with the output current and then utilize the voltage drop across this resistor in the same way that is done with a voltage control circuit. Thus a

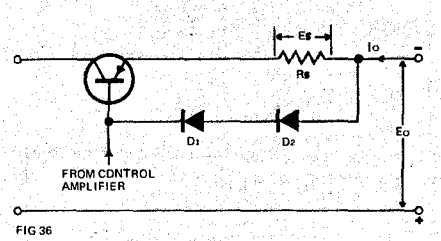


FIG 36

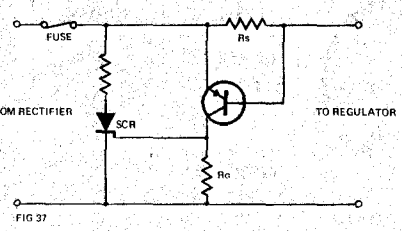
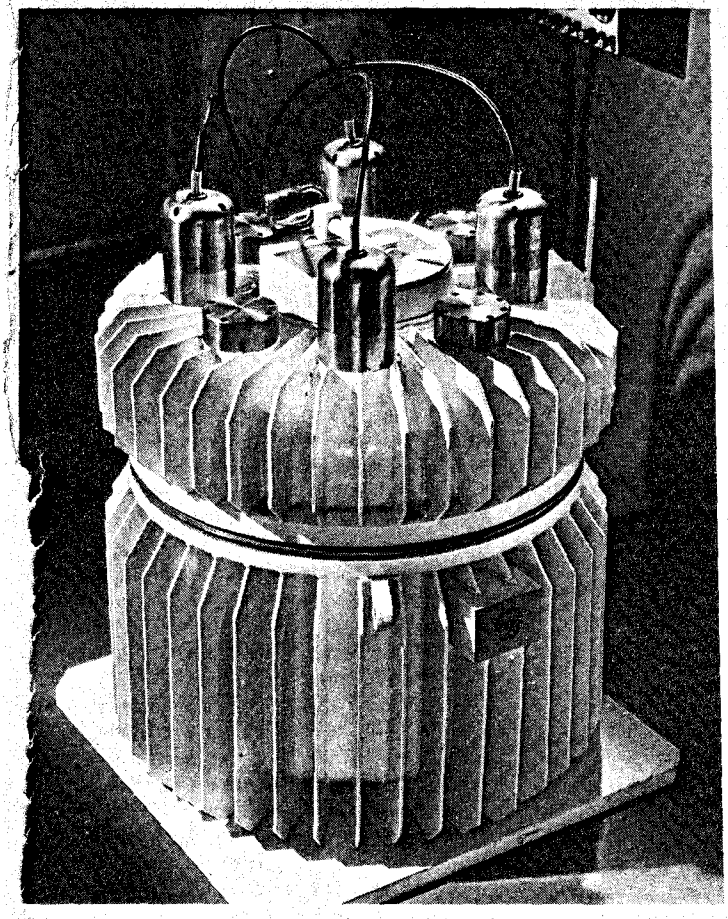


FIG 37

basic current limiting circuit is as shown in Fig. 36. Diodes D1 and D2 are non-conducting when the forward voltage drop across them is less than 0.25V for germanium diodes and 0.7V for silicon diodes. But if the volt drop across R_s exceeds this level, the diodes will conduct and provide negative feedback which reduces current through the transistor. If R_s is made variable, the short circuit current may be altered as desired.

Another type of overcurrent protection that is quite commonly used is "crowbar" protection. (Fig. 37) In broad principle this consists of switching a short circuit across the output of supply and before the input of the circuit to be protected and then relying on the supply protection to operate. This is useful because the short circuit can be switched in very quickly, thus protecting following semi-conductors, and the fuses can then operate with their usual time lag without any danger to the remainder of the circuit.

The value of Rs is chosen so that normally the transistor is cut off and so, therefore, is the SCR, but if the current rises to an unsafe value the voltage across Rs will increase and turn the transistor on, producing a voltage across R_G and so triggering the SCR which will conduct heavily within about 20 microseconds, well before the one millisecond or so danger time for semi-conductors. The fuse will then blow after say 10 milliseconds. The main limitation of this type of circuit is that there may be some sharp transient effects produced by the rapid switching of the SCR. These may be sufficiently large to endanger the circuit which it is intended to protect.



This radio isotope powered generator provides electrical energy for a major marine navigational light.

OVERVOLTAGE PROTECTION

Wherever semi-conductors are used it is essential to safeguard against overvoltages which may breakdown the semi-conductor structure and allow excessive currents to flow.

There are various causes of overvoltages. The main ones are as follows:

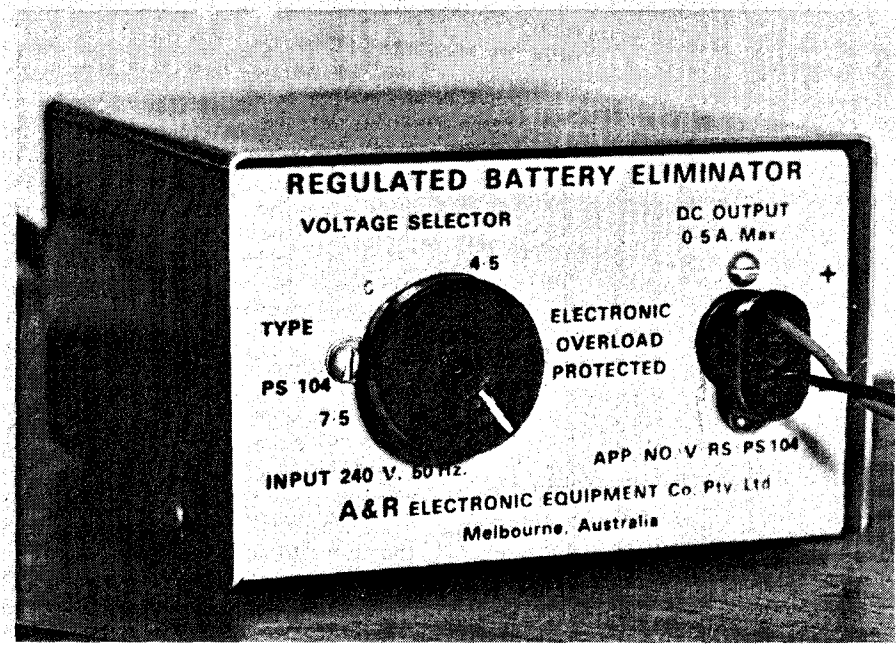
(i) Hole-storage effect. When a semi-conductor is switched on (or off) there is a time lag before the minority carriers move into (or from) the base region. This tends to act as a capacitor, giving a voltage spike on switch on (or off) This is normally reduced by connecting small capacitors across the line.

(ii) When a short circuit is interrupted by a fuse an overvoltage is developed the magnitude of which depends on the arc voltage and the circuit of the power supply.

(iii) Transient voltages are similarly produced when a circuit breaker opens.

(iv) If an unloaded rectifier is disconnected on the ac side, some of the magnetic energy stored in the core is converted to electrostatic energy in the winding and lead capacitance.

(v) Ac supply transients will be



Regulated power supply made by A & R Pty. Ltd., in Melbourne is double insulated to meet APO requirements, and has outputs from 4½ to 12 volts at 0.5 amp.

transmitted across the transformer. The usual protection for all these overvoltages is to use diodes with a voltage rating of at least one and a half times the peak inverse voltage.

All transient voltages may be reduced by connecting capacitors into the circuit which absorb the energy of the transient pulse (by charging up to the pulse voltage).

In many cases a more sophisticated form of overvoltage protection is desired, and this may be obtained either with a simple zener diode as shown in Fig. 38, or a crowbar circuit as shown in Fig. 39.

If the output voltage rises above the zener voltage the zener will conduct heavily, so shunting the output.

If the output voltage rises the zener diode will conduct and pass a current to the gate of the SCR thus triggering it. This places a short circuit across the supply and blows the fuse.

The circuit of Fig. 38 is self-restoring, while that of Fig. 39 is not. That is to say once the overvoltage has ceased to exist the circuit of Fig. 38 returns to normal operation, whereas the fuse must be replaced in the circuit of Fig. 39.

These circuits are usually only required for special applications, and for in-built supplies for various equipment it is usually sufficient to use conservatively rated diodes, and a capacitor or two.

OVERPOWER PROTECTION

Overpower protection is not used widely since it will usually be accompanied by overcurrent or overvoltage.

However, in some applications there may be a particularly expensive device, or some critical apparatus which must be protected from excessive power dissipation (with its consequent excessive heat build up).

One of the simpler techniques is to fix a thermistor to the heatsink of the component to be protected as shown in Fig. 40.

The potentiometer is adjusted so that at normal operating power the SCR is non-conducting, but if the power rises so does the temperature, thus lowering the thermistor resistance and increasing the SCR gate voltage. This type of circuit is not very accurate (±10°C approx.) but may be refined if need be, to give better sensitivity.

The methods of protection described above are by no means the only ones available, but are certainly the most widely used.

USE OF INTEGRATED CIRCUITS IN POWER SUPPLIES

Bridge rectifiers in integrated circuit form have been available for several years now. They consist of the four diodes of the bridge rectifier combined inside a single package with two ac terminals and a + and − terminal.

More recently integrated circuit

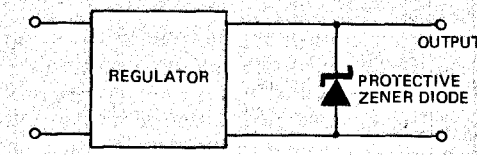


FIG 38

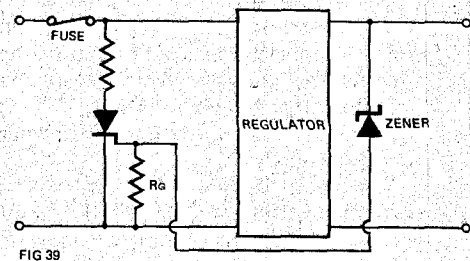


FIG 39

regulators have become available (see ELECTRONICS TODAY June 1971 for an example), and there are also integrated crowbar circuits on the market. The main limitation of integrated circuits for power supply applications is their power ratings. Existing ICs cannot cope with the power which discrete devices can handle, at least at their present stage of development. Otherwise, integrated circuits give the same advantage in power supplies as in any other circuit.

The theoretical circuits considered so far require some additional components before they become useful practical circuits.

A PRACTICAL CIRCUIT EXPLAINED

The series regulated supply shown in Fig. 41 combines controlled voltage and current limiting and uses zener diode ZD1 as a reference source.

Reference diode ZD1, which is supplied by resistors R1 and R2, clamps the base of transistor Q4 at a fixed potentional. Capacitor C1 smooths out any 100 Hz ripple from the input.

The output voltage of the power unit is sampled by R6, RV1 and R7 and this is compared against the zener reference voltage by transistors Q4 and Q5. The voltage at the base of Q5 is the zener voltage minus the two base-emitter voltages, i.e. $V_z - 1.2V$. The output voltage is then this voltage multiplied by the ratio of the resistors in the divider chain.

The output of the comparator is taken via R5 to the output stage consisting of transistors Q2 and Q3.

The action of this part of the circuit is as follows, if the output voltage drops (because the load has increased) then the difference between the zener reference voltage and the divided output voltage will increase. And since this voltage appears across the base — emitters of Q4 and Q5, these

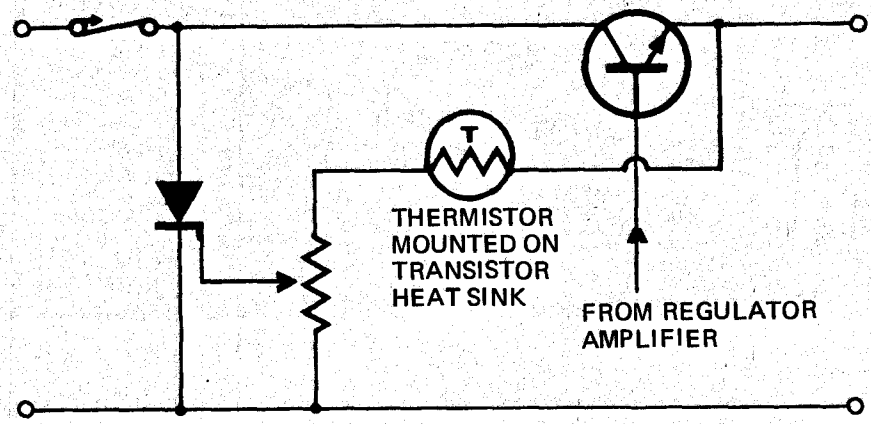


FIG 40

transistors will pass more current. This causes Q3 and Q2 to conduct more heavily, thus reducing the voltage drop across them and so allowing the output voltage to rise and compensate for the increased load; for every load there will be a stable output voltage the regulation of which is dependant on the gain of the comparator amplifier.

The second mode of operation is current limiting, and this is used to protect both the power unit and the load in the event of a short circuit or load that exceeds a predetermined level.

When the current increases beyond a predetermined level, the voltage drop across R3 is sufficient to bias transistor Q1 into conduction. When this occurs the output from the voltage comparator Q4, Q5 is progressively removed from the output transistors Q3 and Q2; these in turn reduce the excess current flowing into the load and an almost constant current is now supplied to the load regardless of any further load increase.

POWER SUPPLY PERFORMANCE CRITERIA

(i) **LOAD REGULATION**
Load regulation is a measure of the ability of a power supply to maintain a constant voltage at its terminals regardless of load variation. The regulation is normally specified as a percentage of the nominal output voltage for a fixed voltage supply or of the maximum voltage of a variable voltage supply. So if regulation of a 50V supply is given as say 0.01%, the terminal voltage will not fall below (5 − .005)V or rise above (50 + 0.005)V.

(ii) **LINE REGULATION**
Line regulation is a measure of the ability of the power supply to absorb changes in the ac mains voltage while holding the output voltage steady. The ratio of the change in output voltage for a change in mains voltage multiplied by 100 gives the line regulation.

(iii) **RIPPLE**
This may be measured with either a true rms reading meter or with a cathode ray oscilloscope. Then ripple is

$$r\% = \frac{\text{rms of ac component}}{\text{dc component}} \times 100$$

(iv) **TEMPERATURE STABILITY**
The output of a power supply should be constant, regardless of temperature. A performance figure is sometimes quoted in mV/°C.

(v) **CURRENT STABILITY**
The above four quantities may be evaluated for current stability by inserting a series resistor in the circuit so that the voltage produced across it is proportional to the current.

(vi) **TRANSIENT RECOVERY TIME**
In some applications it may be important that should the loading be sufficient to force the output outside the tolerance band set by the regulator, the supply will re-adjust itself swiftly. The transient recovery time gives a measure of the speed of re-adjustment.

(vii) **LONG TERM STABILITY**
There is some drift in the performance of a power supply if it is used continuously for say 8 hours. The % change in output voltage may be quoted per 8 hours, 12 hours, 24 hours or whatever the maker specifies.

In assessing the performance of a power supply note should also be taken of its overload protection facilities, and of any transients observable on switch on/off, or with operation of the protective circuits.

The next part of this article which will be published next month, will describe the construction of a general purpose power supply. ●

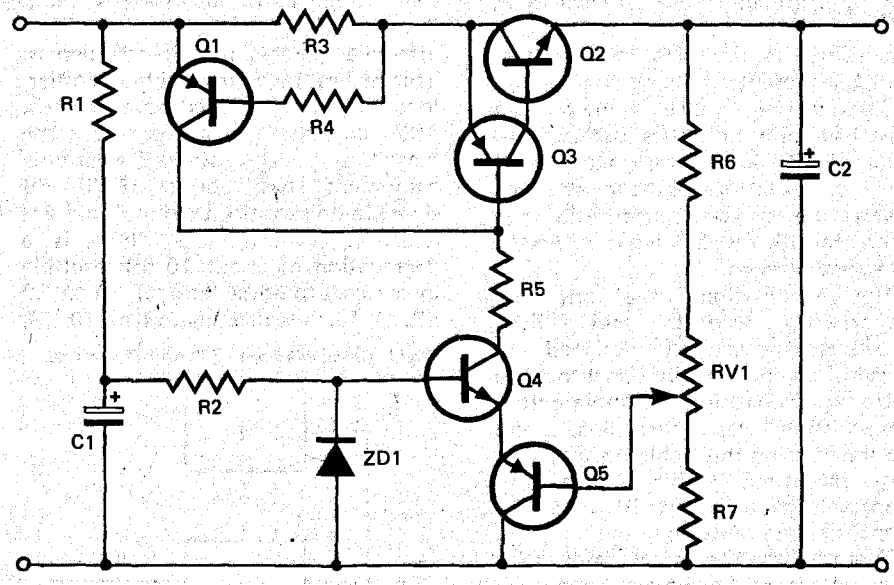
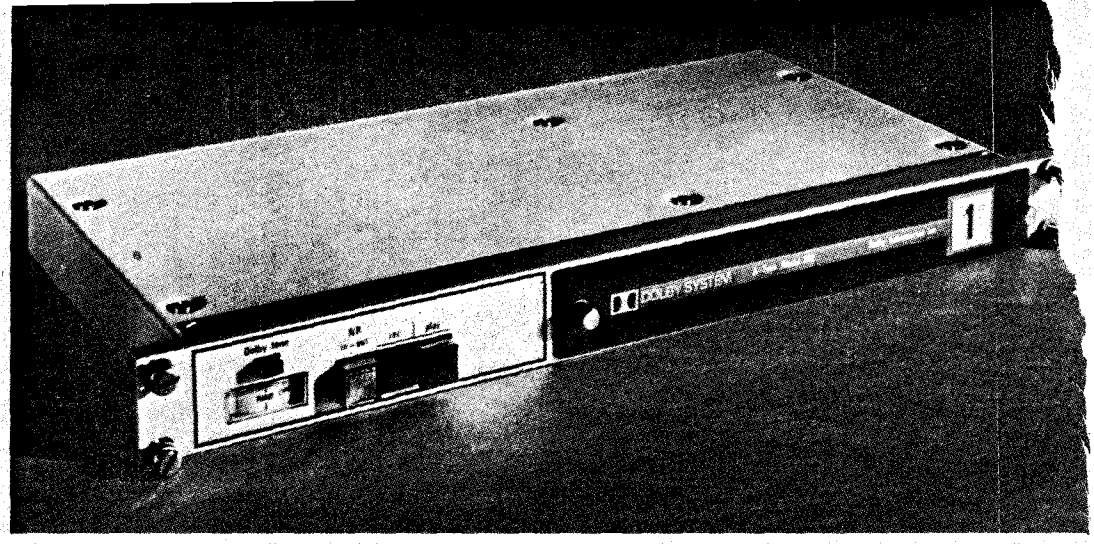


FIG. 41

electronics TODAY
product test



Electronics Today presents the first independent evaluation of the professional Dolby system to be published anywhere in the world — tested by Murray Wood, B.E., BSc., M.E. of Louis Challis & Associates

THE DOLBY NOISE REDUCTION SYSTEM

ONE major weakness in tape recording, radio transmission, and to a lesser extent disc recordings is the high level of hiss which is present on the medium.

Typically the maximum signal-to-noise ratio lies between 40 and 65 dB. At the maximum signal level this is adequate. At lower signal levels, the signal-to-noise ratio may drop to 10 dB (or less) at breaks between passages.

The equalisation used on tape recorders, records and F.M. broadcasting are all designed to provide an increase in signal-to-noise ratio by emphasising the treble before transmission or recording, and de-emphasising the treble on playback or reception. This gives an improvement of about 10 dB in the signal-to-noise ratio.

There are good technical reasons why this equalisation technique cannot be taken further to give an additional 10 dB signal-to-noise ratio. The first and most important of these is hum. De-emphasising the treble results in an effective increase in the bass signals. This makes the hum, rumble and other low frequency defects more obvious. The current generation of tape recorders and other electronic equipment has about 60-70 dB signal-to-noise ratio. Using the present equalisation techniques, there is a degradation of about 10 dB resulting in a signal-to-noise ratio of 50 to 60 dB. A further degradation of 10 dB, would be unacceptable to most listeners.

Another problem that occurs is the limitation that is always imposed on high frequency content.

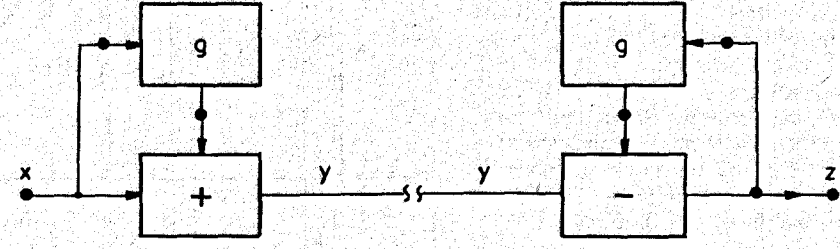
On a record, this limitation is the maximum velocity at which the pickup stylus will track. The higher the frequency and the higher the signal level, the higher the stylus velocity and any treble pre-emphasis makes it harder for the pickup to do its job adequately.

When we look at a tape recorder we find that we have similar problems due to the demagnetisation of the tape (that has just been recorded) by the signal that is being laid down at that instant. This effect is worsened by high-level high-frequency signals. Print through of the recorded signal onto the preceding and succeeding layers of tape on the take-up reel is also increased by high-frequency high-level signals.

The bandwidth of an F.M. broadcast is dependent both on the frequency of the signal and the amplitude (see article on Bruel and Kjaer 7001 F.M. tape recorder in September issue of ELECTRONICS TODAY for theory). Since the available bandwidth to be used is limited both by international agreement and by the receiving equipment used, there are very definite limitations imposed on this medium also.

The problem which Dr. Dolby and many others have investigated is how to increase the signal-to-noise ratio at

Fig. 1. Block diagram of Dolby Processor.



low signal levels where the limitations imposed on the relative levels of high frequency components are not important.

COMPRESSION AND EXPANSION

One of the solutions used in the past has been to use compressors during recording or transmitting, and expanders when replaying or receiving.

The compressor effectively reduces the dynamic range of the signal being fed into the medium by having a low gain at high levels and a high gain at low signal levels. But a major problem with a compressor is the choice of time constants. If it works too quickly, it will distort low frequency signals by following the instantaneous signal levels. If it works too slowly the resulting signal will sound unnatural, because when the signal level drops, the level will slowly increase as the compressor starts to work. When the signal level increases, the compressor once again will take some time to act, resulting in the production of excessive instantaneous levels that may cause distortion, followed by an unnatural decrease in level.

The choice of time constant is therefore very difficult. Given that an adequate time constant can be chosen, the problem is by no means solved. Having designed a compressor, it is then necessary to design an expander which *exactly* complements the characteristics of the compressor. This is usually a very difficult task to achieve, particularly when there is every possibility of an error in system level alignment.

The Dolby system overcomes many of the limitations of conventional compressors and expanders.

The first and most significant feature of the Dolby system is the use of the same nonlinear network in the compression mode as that used in the expansion mode. This guarantees that the two sets of characteristics are the same.

The direct signal, and the signal from the non-linear element are added together in the compression circuit. In the expansion circuit this signal from the non-linear element is subtracted via a feedback loop. The result is that the compression and expansion modes are exact inverses of each other.

The second major difference is that unlike earlier systems, the Dolby system does not perform any processing of high level signals. This means that at normal signal levels, there is no possibility of mistracking between the compressor and expander and at lower signal levels, the degree of mistracking is not so serious.

Inspection of the block diagram in Fig. 1 shows that.

$$y = (1 + g)\,x$$

and

$$z = \frac{1}{1+g}\,y$$

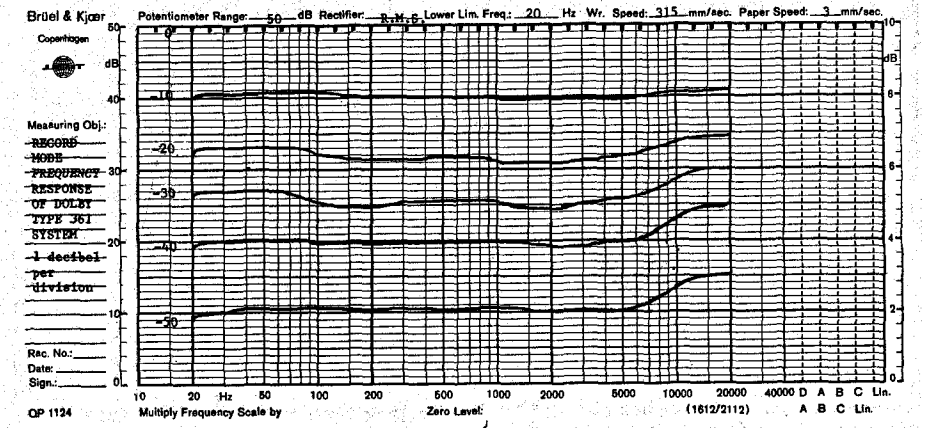
where g is the nonlinear network. The final output from the processor is therefore exactly equal to the original input to the processor. (The frequency response and dynamic characteristics of nonlinear networks are largely unimportant so long as similar nonlinear networks are used in the record and playback modes.)

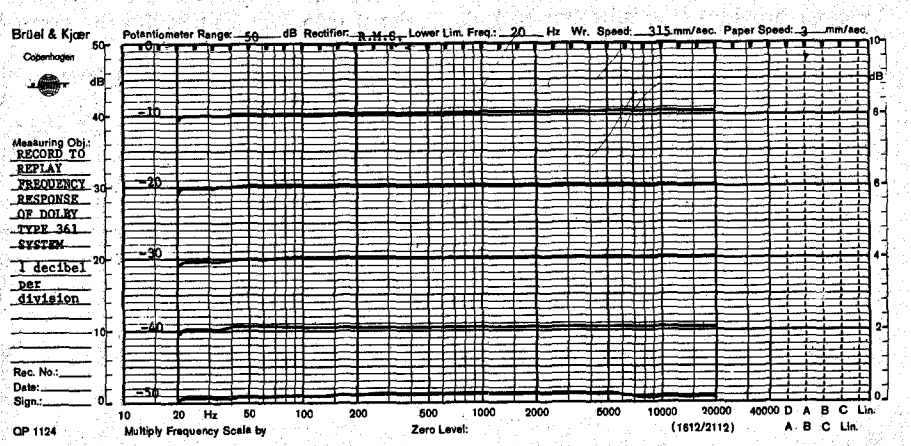
THE DOLBY SYSTEMS

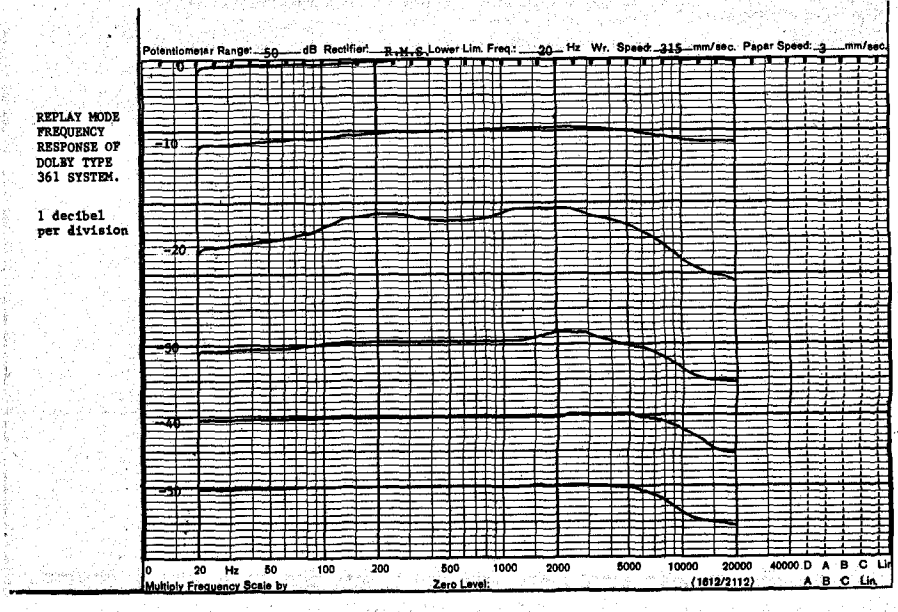
The Dolby technique is available in two basic systems, the Dolby A and the Dolby B.

The Dolby A system is designed for use in professional applications and the Dolby B for domestic applications.

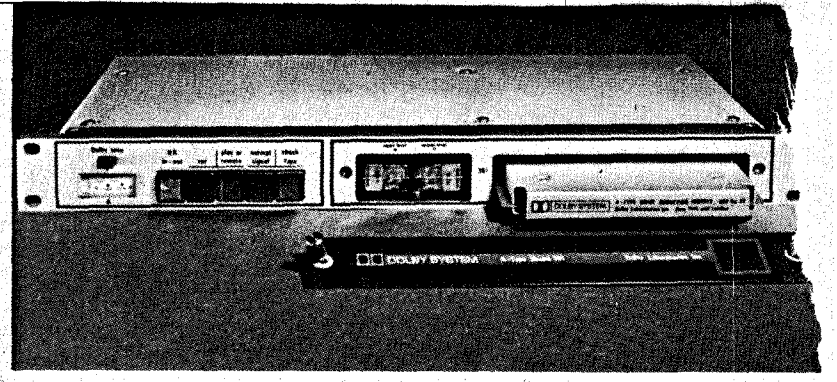
The Dolby A system has a nonlinear network which consists of four separate channels, covering the entire frequency spectrum. The first channel contains the information up to a frequency of 80Hz, and the second the information between 80Hz and 3kHz.







THE DOLBY NOISE REDUCTION SYSTEM



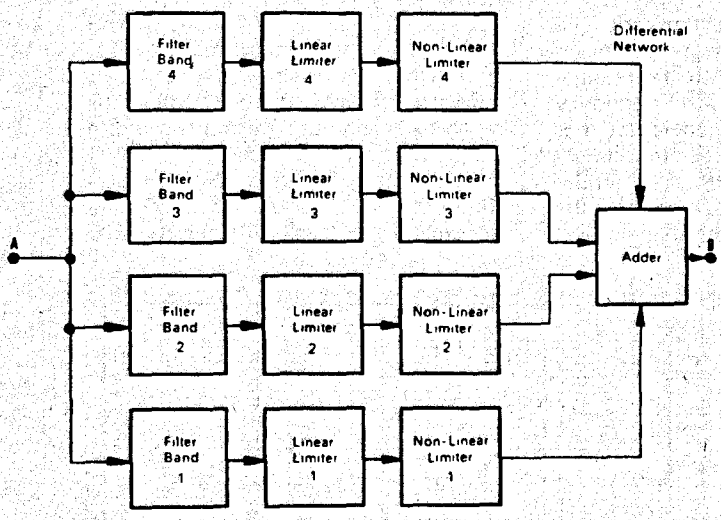


Fig. 2. Block schematic of the non-linear element in the professional Dolby system Model 361.

The third channel operates between 3kHz and 9kHz, and an additional channel operates on the information above 9kHz. The three lower frequency channels provide 10dB compression or expansion at low signal levels while the high frequency channel provides an additional 5dB at frequencies above 9kHz. Because of the use of compression only at low signal levels, the dynamics of the compressor and expander become less critical. The Dolby A unit, therefore, has an attack time constant of 0.1 seconds. This would be considered too long for normal compressors but, because of the system used, the overshoot of the output is normally less than 2dB although it is about 15dB on the output of the actual nonlinear element. The figure of 15dB is a fairly typical overshoot of a normal type of compressor with an attack time constant of 0.1 seconds.

Because of the separation of the signal into four bands, the compressor is almost always in use in one or other of the bands. With the normal level and frequency distribution of classical music, Channel 1 is compressing fairly often, Channel 2 is compressing almost all the time, Channel 3 fairly often and Channel 4 is rarely compressed.

The Dolby B system uses the same basic principle except that only one channel is used in the interests of simplicity and cost-effectiveness. The single filter is designed to operate in approximately the same frequency range as Channel 2 in the Dolby A system. It copes extremely well with the typical hiss problems in domestic reproduction.

The actual performance of the domestic Dolby system is separately reviewed on page 35 of this issue.

In our testing of the professional Dolby system, we were particularly impressed by the precision with which individual Dolby processors are made. We used one processor in the record mode and a separate unit in the playback mode to allow real time testing. This enabled us to use a three head tape recorder and even an electronic simulation of a noisy tape recorder for the testing. Even using this testing procedure, the quality of the performance was exceptionally good proving the compatibility of different Dolby units. This is an essential feature for professional use where one unit may be used for the original recording and another for the final processing.

It is interesting to note that if the original signals are "Dolbyised", then mixing, editing and dubbing can all be performed on these tapes, and only the final product needs to be "re-Dolbyised". This can be very convenient, and is made possible by the relatively high tolerance of the Dolby system to level changes.

The compression provided by the Dolby A system is not applied uniformly over the entire dynamic range, but only over the range 20 dB to 40 dB below the reference level. The compression is relatively flat over the range 20 Hz to 5 kHz and has a maximum of 10 dB. Above 10 kHz another 5 dB of compression is used. It is this relatively flat performance which means that, although the level from record to replay may not be exactly correct, the only audible error that will be introduced is a slight error at the high frequency end of the spectrum. The dynamic range will be slightly altered, but this will not be audible.

It was suggested in an article (from Dolby Laboratories) on the Dolby system, that it could be used for

DOLBY 361 SYSTEM. SERIAL NUMBERS 1060 AND 1062

MEASURED PERFORMANCE

RECORD TO REPLAY FREQUENCY RESPONSE WITH TWO SEPARATE SYSTEMS
20 to 20 KHz within ± 1dB over 50dB signal range.

TOTAL HARMONIC DISTORTION

Reference Level	20Hz	1kHz	6.3kHz
0dB	.17%	0.05%	0.05%
-20dB	.3%	0.05%	0.05%
-40dB	.1%	0.05%	0.05%

INHERENT SIGNAL-TO-NOISE RATIO 75dB TYPICAL NOISE REDUCTION
CONSTANT % BANDWIDTH RANDOM NDISE

Relative Noise Level (dB)	Resultant Dolby Noise Reduction (dB)
-10	0
-20	1
-30	6
-40	12
-50	12
-60	11

CONSTANT POWER PER UNIT BANDWIDTH RANDOM NOISE

Relative Noise Level (dB)	Resultant Dolby Noise Reduction (dB)
-10	0
-20	2
-30	6
-40	10
-50	10
-60	10

PURE TONE NOISE REDUCTION

Relative 50 Hz Noise Level	Resultant Delay Noise Reduction (dB)	Relative 150Hz Noise Level	Resultant Delay Noise Reduction (dB)
0	0	0	0
-10	½	-10	0
-20	4	-20	1
-30	10	-30	8
-40	10	-40	9.5
-50	10	-50	9
-60	9	-60	9

reprocessing old records and other low grade material for re-release. We therefore decided to try this out. The only processing which could be used, of course, was the expansion following playback. The results of this test were quite dramatic. The record we used for the test was a 78 rpm disc in fairly good condition but with a high level of background hiss. By passing it through the Dolby expansion circuit, the only audible effect was a drop in the background noise of about 10 dB. Although we knew that there had been expansion of the signal and that those signals which were quiet were now even quieter, this effect was not readily noticeable and the overall effect was worthwhile.

Based upon this test, one of the useful applications of this 'partial Dolbyisation' would be in the area of satellite broadcasts where there may be a significant decrease in signal-to-noise ratio. Even if the signal is not 'pre-Dolbyised', post-processing would still improve the quality of the signal.

HOW IT PERFORMED

The professional Dolby system proved to be particularly well behaved for a compressor-expander, with no apparent vices.

Alignment took only a couple of minutes and once aligned the Dolby unit performed predictably and well, with all the tests we applied.

The harmonic distortion was less than 0.2% over the entire range of levels under steady state conditions and did not exceed 1% under transient conditions. The distortion was primarily second harmonic distortion. The frequency response was within ±0.5dB with respect to the correct meter setting of the reference tone at the reference level.

Functionally, the professional Dolby system is very easy to use. The type we tested was the Model 361. This has only six push buttons on the front panel. The labeling on each push button indicates its function and we found no trouble in operating the unit.

The unit has provision for remote control operation from an external switch. This may be the record switch on a tape recorder or some remote panel switch. This provision will prove to be particularly useful in the normal application of the professional Dolby system.

The unit is aligned by trimming potentiometers normally hidden under a hinged panel.

A reference tone is provided within the unit, and the use of this, together with the trimming potentiometer enables rapid alignment of the Dolby unit in conjunction with the equipment with which it is to be used.

However, the quality of construction is such that it is probable, that once installed, the only problems will come from moving parts such as the relays and the trimming potentiometers, and these should be good for many thousands of operations.

The unit is constructed in a 19" rack mounting module only 1¾" high. The power consumption is particularly low, being about 15 watts. These two factors should allow easy installation in existing equipment without causing problems due to space requirements or overheating.

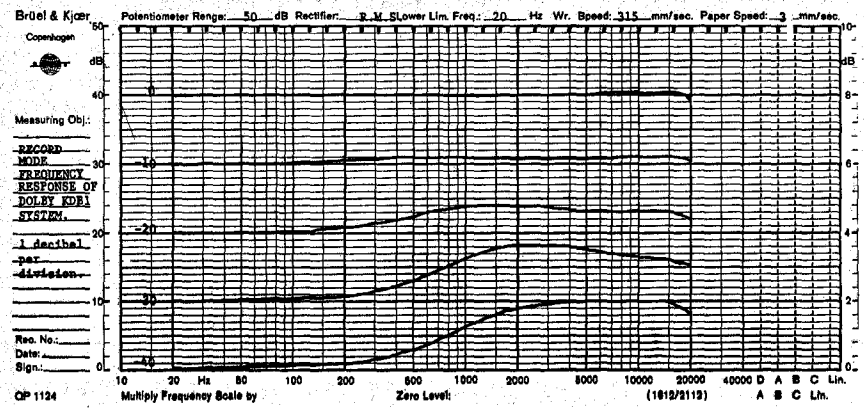
In all its characteristics, the professional Dolby system should meet the requirements of almost any user who has signal-to-noise problems.

The users may range from recording studios to television and broadcasting stations, or even to the dedicated amateur tape recorder user who has about $1,400.00 to spend (per stereo) and for whom nothing but the best will do. ●

DOMESTIC DOLBY

electronics TODAY product test

We test the Kellar KDB–1 Dolby System



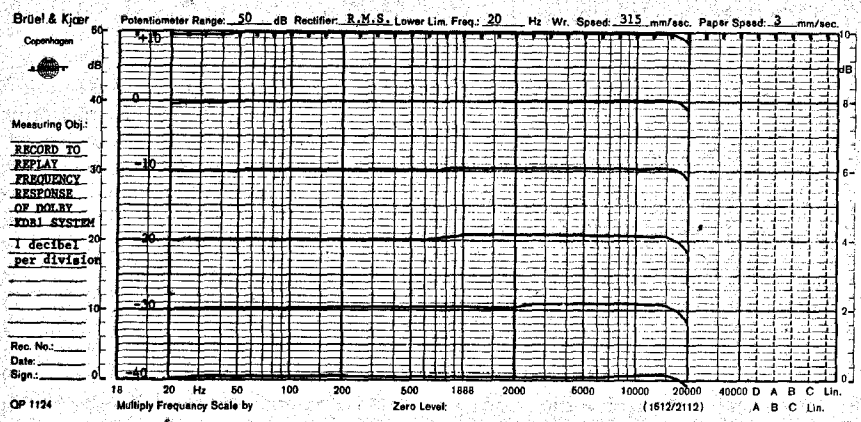
COMPARING the professional Dolby system reviewed in the previous article with the domestic Dolby system reviewed here is like comparing a Rolls-Royce and a $2000 car. The domestic unit which we tested was manufactured under licence from Dolby Laboratories Inc. by Keller Electronics Ltd. in Great Britain. It stood up to the comparison remarkably well.

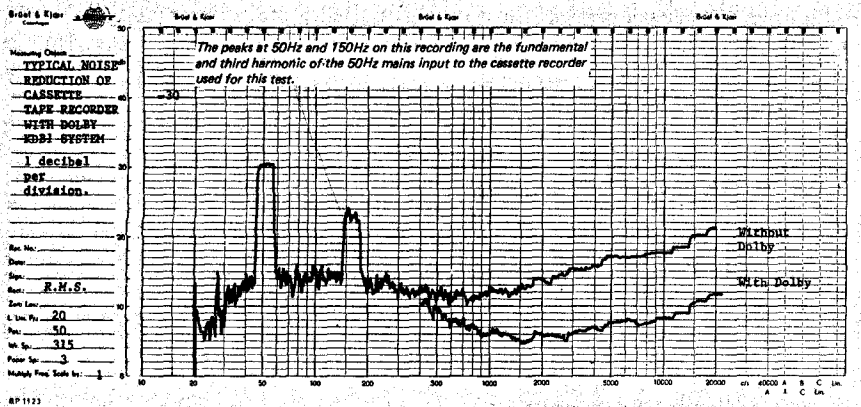
The unit consisted of two processors designed for stereo use. Connections are made by standard DIN patch cords. These plug directly into most amplifiers and tape recorders, making for the greatest simplicity in connection.

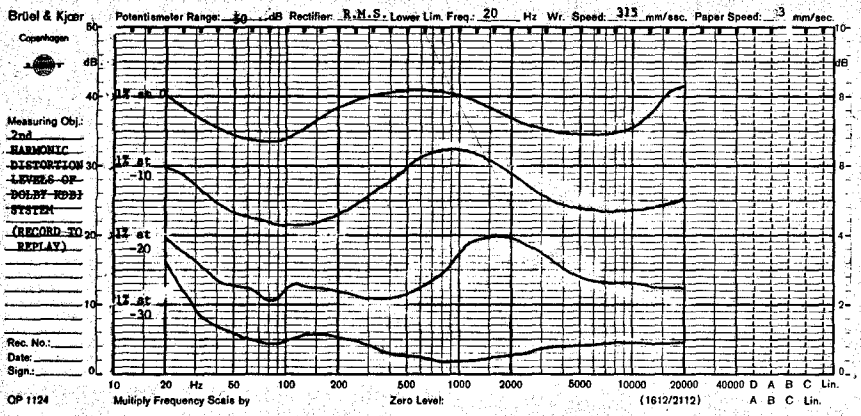
The major simplification of the domestic (or 'B' type) Dolby system is that instead of four processing channels, only one is provided. This provides compression or expansion at frequencies above approx. 3kHz. Whilst this is a limitation, it reduces the price by a factor of four, while still meeting most of the requirements of the amateur or audiophile.

We unpacked the system and plugged it into a tape recorder and amplifier, but then found it difficult to interpret the very brief instructions provided with the unit since the manufacturer

DOMESTIC DOLBY







MEASURED PERFORMANCE OF KELLAR DOLBY B NOISE REDUCTION UNIT KDB-1 SERIAL NO. 600261.

FREQUENCY RESPONSE 20Hz to 20kHz ± 1dB
(At Dolby reference level)
Total harmonic distortion (see level recording)
Signal-to-noise ratio (re Dolby reference level) 70dB
Channel separation 50dB at 1kHz
Tape recorder noise reduction 2dB at 400Hz
9dB at 20kHz

has deliberately set out to give the user the minimum amount of information about how the unit works, even to the omission of a circuit diagram. While we understand the manufacturer of such equipment wishing to withhold circuit information, we feel that it must be compensated for by the provision of very simple instructions. (We understand that the Australian distributors are currently preparing a more comprehensive handbook.)

The procedure required for setting up is to play a prerecorded tape containing a known reference level signal. This establishes the gain of the output amplifier or the tape recorder. The system is adjusted by the use of a preset gain control in each channel. It is intended that the tape recorder output gain controls and the preset gain controls on the Dolby unit should be moved together so that the gain of all sections is about mid range.

Having established the output conditions, a signal is recorded on the tape from the built-in reference oscillator which must be adjusted to give the required level on playback. This in itself is a fairly complex procedure since it requires the recording of a signal for a few seconds then playing back, then rerecording to obtain the required level. Having performed this operation the system should be ready to use.

Problems began to arise when trying to set up the system. Instead of just having one record level meter and level control per channel, there are now two meters and two controls per channel and one common control for both channels. The problem is to establish which control to use and which meter to believe. This was a problem which we could not resolve quickly so we finished up leaving it largely unanswered.

When one comes to record or play back, it is essential that the correct function buttons be pressed (on the Dolby unit) otherwise the system may go into oscillation. We found that even though we knew this, on several recordings that we made we ended up with a garbled mess on the beginning of the tape because of wrong control settings.

One further problem that we had with controls, was that the monitor position can either be 'Normal', in which case, it monitors playback 'Dolbyised' or alternatively it can be 'Replay Input' in which case it monitors on the playback head of a 3 head machine, in the record mode, or playback mode without the Dolby processor in the circuit.

The result is that one becomes thoroughly confused by the vast number of controls and inadequate instructions.

Having spent several hours getting to

this point, we were now in a position to commence testing.

HOW IT PERFORMED

We found that in all departments the Kellar Dolby B system performed well. The level of distortion is a bit high at some levels and frequencies, but being 2nd harmonic distortion, it is not all that serious. The maximum distortion is about 2% at the lower levels of signal input. It would appear that the levels of distortion quoted by the manufacturer are for the non 'Dolbyised' performance. The distortion figures in the Dolby mode are difficult to analyse because they can only be measured for pure tones. Since the distortion is both level and frequency dependant, it is difficult to estimate the likely effect on a listener. We tried several subjective tests and could not *hear* any effects or severe intermodulation distortion or harmonic distortion.

Many of the complaints which we have about the ease of use may not be quite so valid after a longer period of familiarisation.

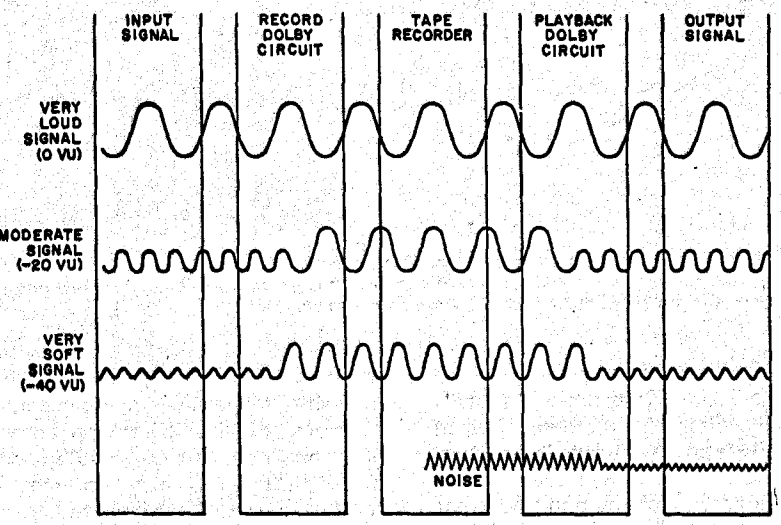
As measured by the end results, the Dolby B system is very worthwhile for the domestic user. We do feel however, that it will probably take some time for him to be able to use the system properly. There is plenty of room for the application of human engineering on this unit so that it can be used more readily by the average user.

We would like to see virtually all the knobs with the exception of the record level control provided as trim pots hidden under a panel. While they are all necessary on the initial adjustment, after this they will probably not be needed. Their inclusion tends to clutter the front panel and make it more confusing for the user.

Another refinement which would add to the ease of operation is the inclusion of a change-over relay which could be operated from the record switches in the tape recorder. While this would add slightly to the cost of the unit and would require a small modification to the tape recorder, it would allow easier operation without the problem of oscillation which occurs if the record replay switch on the Dolby unit is not correctly set. These modifications would eliminate the need to worry about any controls on the Dolby unit other than the record level control and so decrease the user confusion.

In spite of the vast increase in complexity caused by the introduction of a Dolby B unit such as the Kellar KDB-1, the advantages of using it are unquestionable, in terms of the end result. We consider that the Dolby B system will eventually become an integral component in all the better quality domestic recorders (both cassette and reel to reel). ●

HOW THE DOLBY SYSTEM WORKS



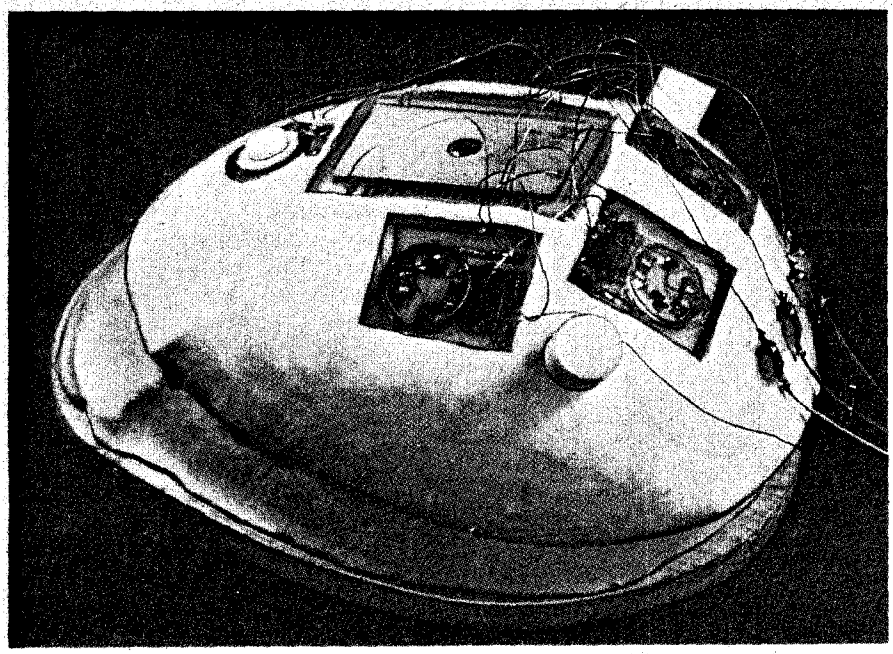
1. The signal being recorded passes through the record Dolby circuit *first*. The Dolby circuit operates on the higher ("hiss") frequencies in a predetermined manner, depending on their loudness level. The loudest signals (0vu) pass unaffected through the circuit. Signals of moderate intensity (–20vu) are boosted moderately, while the very soft signals (–40vu) receive maximum boost.

2. After being thus "Dolbyized," the signal is recorded onto the tape. It is at this point that tape hiss makes its appearance. You can see on the diagram how the record Dolby circuit's action has made the low-level signal louder than usual, relative to the tape hiss.

3. On playback, the signal from the tape is passed through the playback Dolby circuit, which is an exact "mirror-image" of the record Dolby circuit. The playback Dolby *lowers* the previously boosted parts of the signal, by precisely the same amount they had been boosted. The tape hiss – which made its appearance between the record and playback halves of the Dolby System – is automatically lowered at the same time by a very substantial amount, effectively 10 db or 90%. At the same time, because of the precise "mirror-image" playback action, the Dolby System causes no other change in the signal relative to the original source that was recorded.

ARTIFICIAL SIGHT

As electronic devices grow smaller and more sophisticated, so their range of possible applications grows correspondingly wider. One field in which these developments are having an increasing impact is that of medicine. Already research scientists have produced, for example, a number of devices designed to assist those who have lost the use of a particular part of the body, and now a group of British scientists is working on a project which, if successful, will be of enormous application – the development of an artificial system of sight.



Mini implant for implantation into a baboon. This wired-up but as yet unsealed device was built to establish absence of toxicity and resistance to body fluid. One logic package, one row receiver coil and three out of four column receivers can be seen.

THE research team is at the Medical Research Council's Neurological Prosthese Unit at the Institute of Psychiatry in London. A prosthesis is any device designed to replace a part of the human body that has ceased to function (an artificial leg is perhaps a good example), and the unit is concerned with ways of investigating how it might be possible to develop artificial nervous systems.

The director of the unit is a physiologist, Professor G. S. Brindley, and together with an electrical engineer, Mr. P. E. K. Donaldson, he heads a team of research workers which is trying to develop a system by which people who are blind will be able, with the aid of a certain amount of electronic equipment, to distinguish and recognise simple objects, in particular letters and words.

The normal organ of sight, developed over millions of years of the evolutionary process, is the eye. This was originally a simple cell which was sensitive only to changes in light intensity, informing an organism, for example, of the difference between night and day, but during the process of evolution it has become the complicated organ we have today.

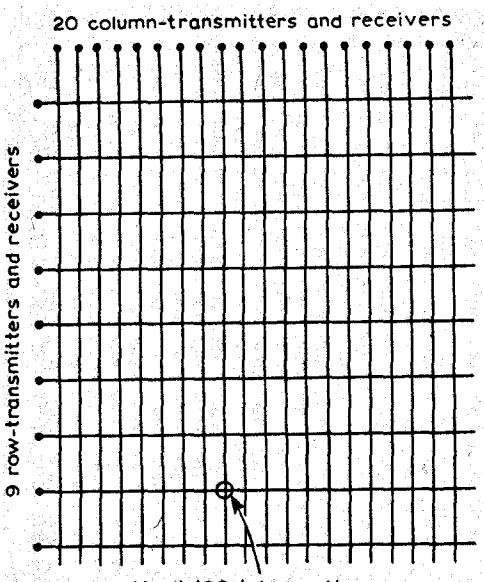
In the eye, incoming light is focused by a transparent lens at the front on to the retina, where there is a layer of light-sensitive receptor cells. When light falls on one of these cells, it is stimulated to produce a minute pulse of electricity which, after a complex system of coding, passes to the brain along one of millions of small optical nerves. The brain arranges all the incoming electric impulses into a coherent pattern which it then matches against its memory store and recognises as a particular set of objects, or whatever the eye is looking at.

To attempt to imitate such a system would be an enormous task, particularly since it is still not understood quite how it works. Professor Brindley's team has therefore by-passed the normal route, and has gone directly to that area of the brain where the signals are received and analysed. The method makes use of a phenomenon that was first observed by brain surgeons in Germany in 1925, namely that when a certain point on the occupital cortex – that area of the surface of the brain which deals with the sensation of sight – is stimulated by the application of a small electric current, a blind patient is able to "see" a small spot of light at a particular fixed position. These spots occur in different places as the stimulus is applied to different parts of the cortex, although each position corresponds to a fixed point on the cortex, and the white spots created in this way appear like bright stars in a dark sky.

It has been realised for a number of years that if some way could be found of applying simultaneous stimuli to various parts of the cortex, a pattern would be built up which would be recognised again by the patient if the stimuli were applied in exactly the same places at a later time.

The practical problems to be overcome, however, were enormous, both from the surgical point of view, since the brain is an extremely sensitive and delicate organ, and that of producing the necessary electrical apparatus. It is only with the development in recent years of miniaturised electronic components and circuits, by which bulky equipment has been reduced to size often little larger than that of a small coin, and with increasingly sophisticated surgical techniques, that it has been possible to devise a system by which these ideas could be put into practice.

The basic way in which the system which has been developed by Professor Brindley, Mr. Donaldson, and their colleagues, works is quite simple. A visual image of the object being looked at is recorded by a television camera or some other means, and this image is then converted into a number of dark



Electrical grouping of transmitters and receivers into a 20 x 9 matrix. By this means 180 points on the visual cortex can be stimulated from only 29 receivers.

or light spots, corresponding to its intensity at a particular point, in much the same way as photographs are reproduced in newspapers. Signals from each spot, indicating whether it is dark or light, are fed to one of a number of small transmitters fitted into a cap which the subject wears on his head. A number of receivers set in a silicone rubber cap are implanted by surgery into the area between the scalp and the top of the skull, each receiver corresponding to one transmitter immediately above it on the outside of the head.

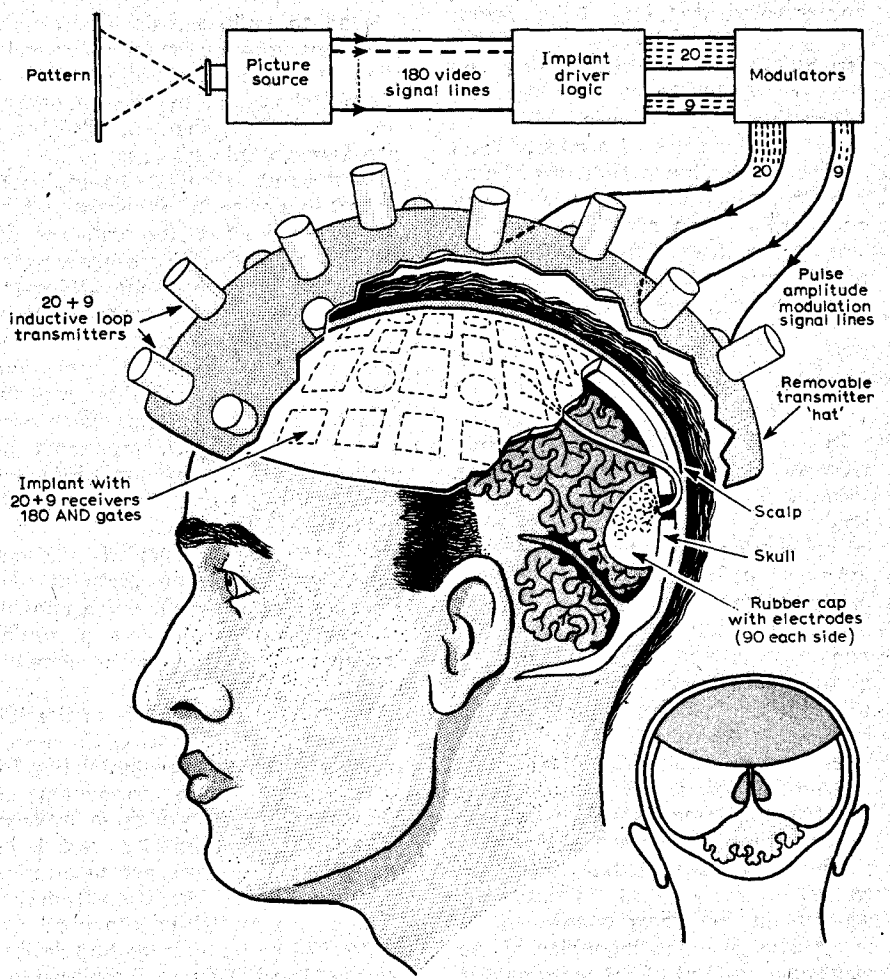
When a transmitter receives a signal from the recorder, it sends out its own small radio signal which is picked up by the corresponding receiver inside the scalp. The receiver then sends a small electric impulse along a wire to a platinum electrode implanted by surgery at a particular place on the visual cortex at the back of the brain, causing the subject to see a white spot.

Thus to each point on the visual cortex there corresponds a certain intensity, an electric impulse is sent via the transmitter and the receiver to the corresponding electrode, causing the subject to see a flash of white light at a particular point in his visual field. Furthermore, if the electrodes are arranged on the cortex in such a way that the flashes seen by the patient correspond to the bright areas of the image being looked at, a pattern will be built up which can then be recognised by the patient as that belonging to a particular object.

The system is similar to that of a television set, in which the intensity of a particular spot on the screen as illuminated by the scanning electron beam corresponds to that at a particular point of the field of vision of the television camera, the information being transmitted from the camera to the receiver by means of radio waves. The image produced by the system described above on the visual field of a blind subject, however, is at present much less sophisticated than that seen on a television screen. Not only is the image broken up into far fewer dots, but also the dots themselves are either light or dark, depending on whether the light falling on the corresponding receptor exceeds a certain level, and any sense of variation in intensity has to be conveyed by the number of spots which have been lit up, rather than by their individual brightness.

The large amount of information that can be conveyed by even the simplest system of dots can be seen from the fact that in the traditional system of Braille used by blind people to read, a combination of only six dots in three rows of two is sufficient to provide a code for all the letters of the alphabet. A coding system, however, has many drawbacks, especially if the blind person has at one stage been able to see and therefore already knows the shapes of letters and words. Professor Brindley's team is therefore aiming to devise a system by which ordinary letters used in normal communication can be recognised by a blind person. It has been found by experiment that if the relationship between the individual shapes of the letters to be projected, and the positioning of the electrodes in the visual cortex – and hence the white spots of light in the subject's visual field – was random, about sixty spots of light would be required to reconstruct the individual letters. At this rate, Professor Brindley has therefore calculated that it will require about six hundred electrodes to be implanted for the subject to be able to read ten-letter words at one time.

The first attempt at inserting a visual prosthesis into a patient was made in 1967. Eighty radio receivers, each one connected to an electrode implanted in the visual cortex, were placed under the scalp of a woman patient, great care being taken during surgery to ensure that any chance of gas



Principle of the visual prosthesis. The visual cortex of the brain is stimulated by electrodes fed from microelectronic receivers in an implant between the skull and the scalp.

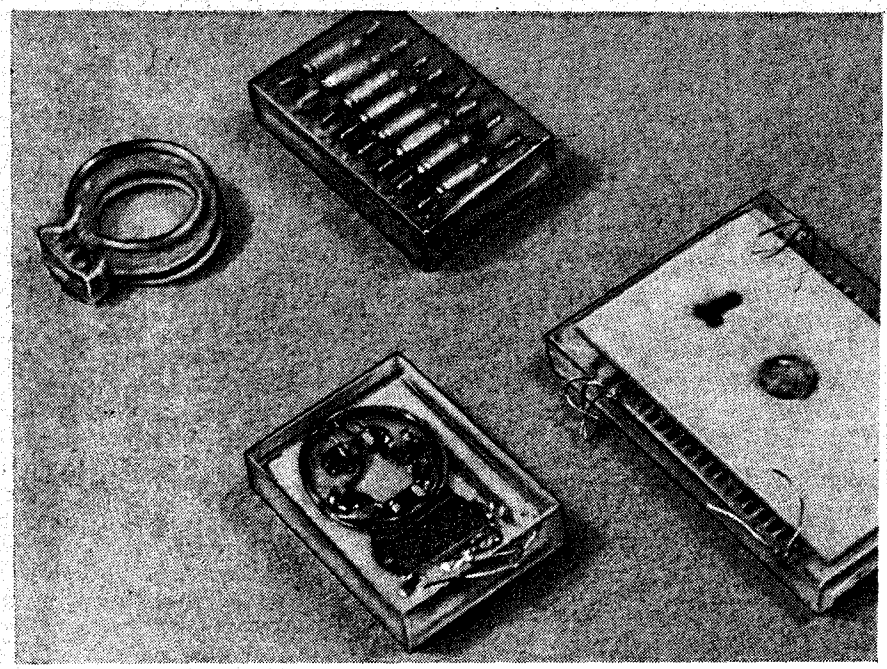
formation or electrolytic damage to the brain was eliminated. Unfortunately, when the system came to be tried out, it was found that only about forty out of the eighty receivers were in working condition, and although the patient was able to see spots of light at this number of positions in the visual field, the way in which they were distributed meant that there were not enough to build up all the letters of the alphabet and so enable her to read individual letters without introducing an artificial code.

The fact that half of the electrodes did work, however, and that twenty of them were still working after three years, showed that such an operation was theoretically possible. And Professor Brindley and Mr. Donaldson have now developed a system with 180 rather than 80 electrodes which, although it has not yet been used on a patient, promises to be far more efficient in conveying visual information to the subject.

To do this, it was impossible to increase the number of transmitters and receivers used, one of the reasons being the sheer weight of the cap required to hold them which the subject would have to wear. An alternative system was therefore devised making use of a grid of rows and columns. The grid consists of nine rows and twenty columns, each row and each column corresponding to a single transmitter outside the head and a corresponding receiver under the scalp. The grid is made of intersecting wires, and at each point of intersection there is a small transistor which performs as a logic device called an *AND gate*.

This means that if the transistor receives two pulses, one from the receiver corresponding to the column and one from the receiver corresponding to the row which intersects it, it will send out its own electric pulse which can be used to activate an electrode. However, if only one pulse is received, or if the two pulses do not arrive simultaneously, the transistor remains inactive. By this method an electrode can be activated at each of the 180 (= 20 x 9) points of intersection of the grid by sending simultaneous impulses from one of the twenty column receivers and one of the nine row receivers, in a similar way to that in which any of the sixty-four squares on the chess board can be referred to by indicating which of the eight columns and of the eight rows it lies at the intersection of.

The great advantage of this system is that only twenty-nine transmitters are required rather than the eighty used previously, and although the electronic circuitry used is more complicated, since two pulses rather than one are needed to activate a single electrode, the transistors are very much smaller than the receivers, and the amount of room taken up by the apparatus implanted under the subject's scalp is considerably reduced.



The four types of package used in the implant: (top left) row receiver coil and capacitor; (top right) block of tantalum capacitors; (bottom left) column receiver; (bottom right) hermetically sealed logic package.

All the components to be implanted are set in a silicone rubber shell which fits neatly between the scalp and the skull of the patient. Together with the transistors which make the AND gates, there are 44 packages that have to be inserted under the scalp in this way, and these are divided into four different groups. The first are the twenty column receivers, which each contain both passive components and diodes, and are encapsulated in epoxy resin to protect them from the body fluids in which they will be immersed for a considerable period of time. Similarly there is the group of nine row receivers, each of which consists of a pick-up coil and a tuning capacitor, and is again encapsulated in resin.

The third group consists of the 180 transistor AND gates. These are divided into nine packages — one for each row — each containing 20 transistors, and each of these packages has to be hermetically sealed to protect the circuit against penetration by tissue fluid. Mr. Donaldson has developed a special glass-to-metal seal to do this, based on a method devised by the Royal Aircraft Establishment. Finally there are six packages each containing a block of fifteen tantalum capacitors, these again being encapsulated in resin.

The sealing is an essential part of the process, since if a particular component fails once it is in place, it would be a long and difficult task taking it out and replacing it with a new one. All the packages are therefore carefully tested by operating them continuously while immersed in a warm saline bath until their performance begins to deteriorate. Already the column receivers have been tested in this way, and have shown no measurable reduction in performance after a period of six months.

Once the implant has been placed in position and the electrodes attached to the cortex, all that remains is to control the pattern of the spots of light seen by the patient. This is done by activating each of the electrodes in turn, and asking the patient to point to that part of his visual field in which the spot appears.

Once the position of the spots stimulated by all 180 electrodes have been plotted in this manner, the information is incorporated into the apparatus scanning the object being looked at, so that it codes the image in a form that will be reconstructed and recognised by the patient.

This system is yet to be tried out on a patient, and until then one can only speculate on its success. Professor Brindley and his colleagues seem confident, however, that they will eventually be able to develop and produce a method of restoring partial sight to blind patients that will enable them both to read and to gain some impression of the objects around them. ●

EXPECT THE UNEXPECTED
THE NEW MIRACORD 770H

The MIRACORD 770 H is the finest record playing instrument ELAC ever developed. It shares all the exclusive features of the top-rated MIRACORD 50 H, however offers the following luxuries.

• **Variable speed control with digital stroboscopic speed indicator.**

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You set a small lever at the top front edge of the cartridge insert for the number of records being played and are sure of a correct tracking angle, whether you use the 770 H for single play or as a changer.

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Now ELAC has 4 MIRACORD Automatic Turntables Available: Model 770 H – 50 H – 630 – 610.

ELAC Turntables can be fitted with a choice of ELAC high fidelity stereo cartridges.

ELAC high fidelity

	STS 244	STS 344	STS 444
Freq. Range	20–20,000	20–22,000	10–24,000
Static compliance (cm/dyn)	18.10^{-6}	25.10^{-6}	33.10^{-6}
Stylus Force	1.5–3	1–2	0.75–1.5
Sensitivity (1000Hz–$10\frac{CM}{S}$)	18.mV	11mV	11mV
Cross talk Damping (dB)	22	24	26
Trackability * >60μM and 100Hz	1.5g	1.g	0.75g

**(Trackability means that at the specified stylus force and frequency, amplitudes of over 60μM will be faithfully tracked. This is well beyond the range of amplitudes occurring on stereo records)*

These cartridges are also suitable for use with any high quality turntable.

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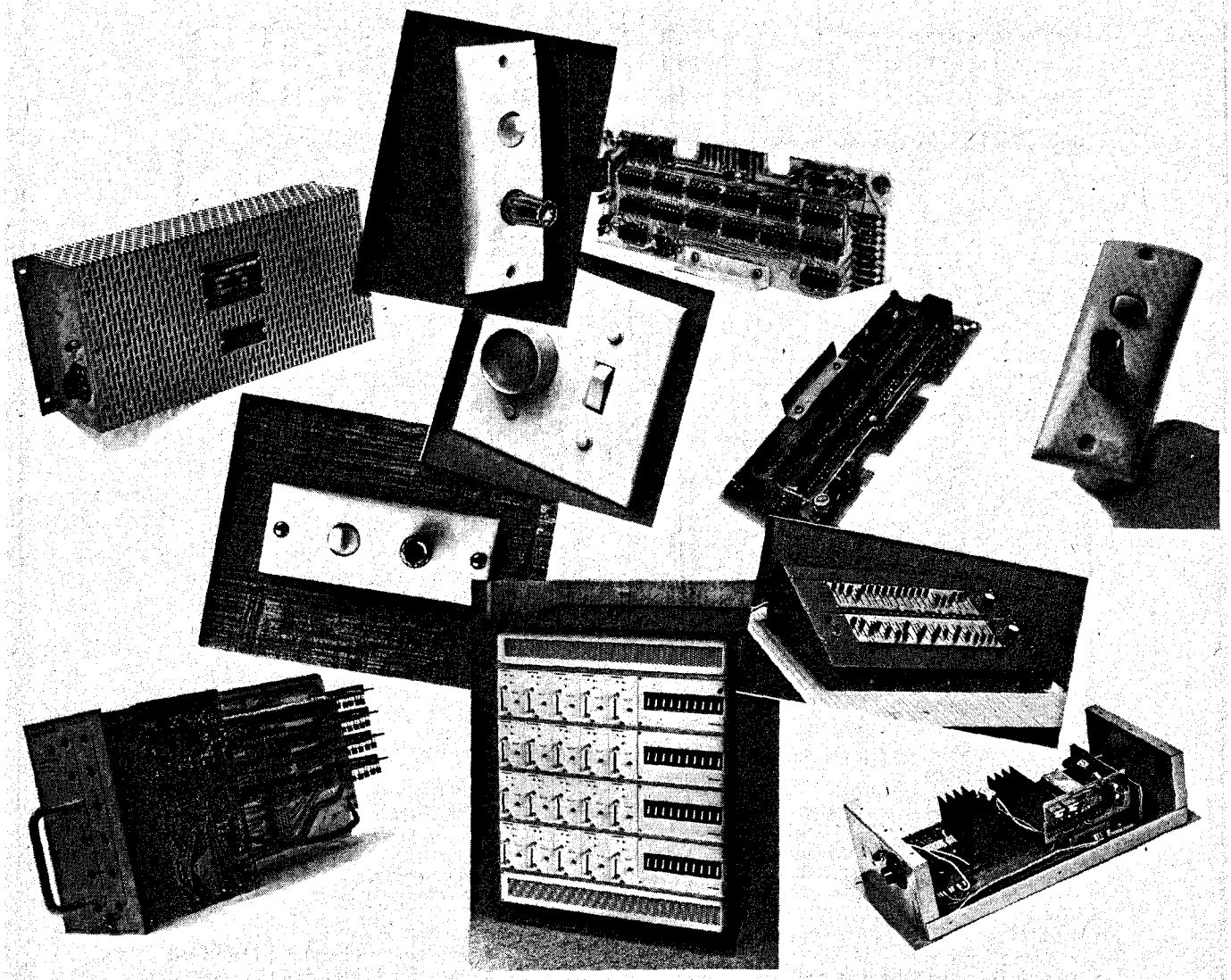
NSW	QLD	W.A.	VIC	S.A.
Magna Tech-tronics Aust. P/L 49 Whiting St., Artarmon, NSW.	**Brisbane Agencies** 78 Wickham St., Valley, Brisbane.	**Diana Investments P/L.** 47 Angelo St., South Perth.	**Musicmaker P/L** 395 Victoria St., North Richmond.	**Newton McLaren Ltd** 82 Gilbert St., Adelaide, S.A.



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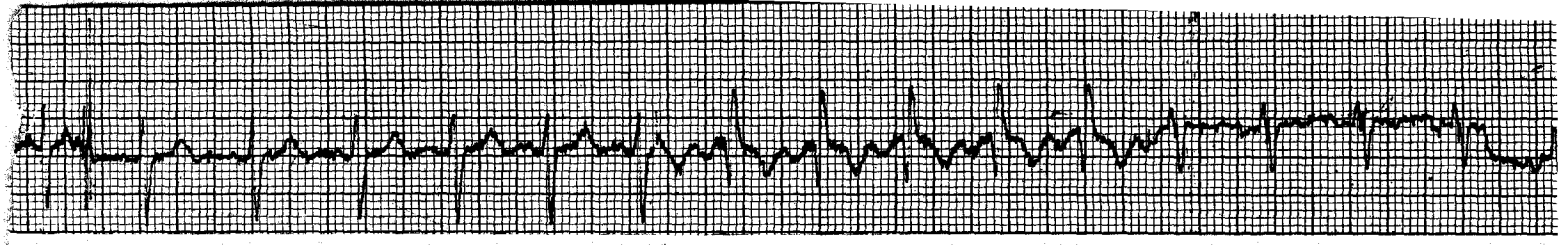


DIAGNOSIS BY SATELLITE

Latest electronic equipment can monitor a patient's heart in Sydney — analyse the data in the USA — and transmit the resultant diagnosis back to Sydney — all within seconds.

Miss Therese Healy (of Medicheck) inspects an electrocardiogram during the recent demonstration at the Sydney US Trade Centre.

BECAUSE of the enterprise and imagination of two men, one an Australian industrialist and the other an official of the United States Department of Commerce, Australia recently played a major part in a medical event that was conducted for the first time.

On Monday August 30, electrocardiographic data taken from a patient at the US Trade Centre in Sydney was flashed directly to the Mayo Clinic in Minnesota, U.S.A., where it was analysed by a computer there.

Within three minutes, the examining doctor in Sydney had the analysis and could then direct appropriate treatment.

The doctor examining the patient at the Sydney Trade Center was Dr. Ralph E. Smith who is Director of the Cardiology Training Program at the Mayo Clinic.

Dr. Smith has carried out valuable research work on computer analysis of electro-cardiograms and is a world authority in this field.

The two men responsible for this event were Mr. Bill Tyree and Mr. Chester E. Norris Jnr.

Mr. Bill Tyree donated the funds to establish the Bill Tyree Foundation which created and directs The Medicheck Referral Centre in Sydney. He made the facilities and services of the Medicheck Centre available for the enterprise.

Mr. Norris is Director of the United States Trade Center in Sydney.

Thanks to the high level of technical competence of the staff of the Medicheck Centre and the typical enthusiasm and energy displayed by Americans when they believe in something, Australia not only has available these modern techniques and services, in the August 30 operation it became out in front leading the way.

TRANSMISSION SITE-
U S TRADE CENTER
SYDNEY, AUSTRALIA
AUG 24, 1971 1151 HOURS

PROCESSING SITE-
MAYO CLINIC
ROCHESTER, MINNESOTA USA
AUG 23, 1971 2051 HOURS (CDT)

CALIBRATION AND RMS NOISE ANALYSIS -

XCAL	YCAL	ZCAL	XNOS	YNOS	ZNOS	CLDV	NSDV
0.93	1.00	0.99	0.014	0.008	0.007	6.	18.

000003 M 41 YEARS

	MS DURATION	MICRO-V MAGNITUDE	VECTOR POSITION	F / T LOOP ROTATION	
P-WAVE -	96				
MAXIMAL SEGMENT		114	LIA		
PR -	172				
R-WAVE -	88				
INITIAL SEGMENT			RSA	CW	CCW
MAXIMAL SEGMENT		856	LIP	CW	CCW
TERMINAL SEGMENT			RIP	CW	CCW
ST -		67	LIA		
T-WAVE -					
MAXIMAL SEGMENT			527	LIA	CW
QT -	392				

NORMAL SINUS RHYTHM, RATE 75
WITH A SUPRAVENTRICULAR PREMATURE COMPLEX
WITH SINUS ARRHYTHMIA
NORMAL QRS-T MEASUREMENTS (41 YEAR OLD MALE)

********** ANALYSIS COMPLETED **********

A first!
Ralph Smith, M.D.

This historic electrocardiographic data is signed "a first!" by Dr. Ralph Smith, Director of the Cardiology Training Programme at the USA's Mayo Clinic.

WHAT IS AN ELECTROCARDIOGRAM?

The heart muscle (myocardium) is an electrically triggered pump forcing blood through the body's circulatory system, and an *electrocardiogram* is a record of the electrical activity accompanying this action.

The electrical pulses triggering the heart muscle are generated within the heart itself and cause the tissue to contract and relax at rates commonly between 60 and 80 beats a minute.

The electrical activity associated with the heartbeat can be detected on the surface of the body. Metal electrodes are placed on various areas of the body and pick up the electrical signals generated by the heart. This voltage is amplified and used to drive an oscilloscope, pen recorder or other output devices.

FLUORESCENT LAMP DIMMING

When electricity supplanted oil and gas lighting, it brought with it hitherto unavailable levels of illumination. But something was lost, and that was control of brightness. The development of solid-state power controls has once again made brightness control possible, and many people use dimmers to control incandescent globes. Contrary to general belief, fluorescent tubes can also be dimmed – this article tells how.

IN RECENT years the development of solid state devices such as the silicon controlled rectifier (SCR), and more recently the Triac, has made practicable the development of compact, light and inexpensive equipment for dimming both incandescent and fluorescent lamps.

Incandescent lamps are fairly easy to dim and a few simple circuits were shown in the article entitled 'A Practical Guide to Triacs' in the July 1971 issue of ELECTRONICS TODAY.

This present article explains how fluorescent lamps can be dimmed – and our constructional project on page 50 of this issue describes the construction of a dimmer that is suitable for both incandescent *and* fluorescent lighting, (some commercially made light dimmers *can* be used to dim fluorescent lights but far better results will be obtained by using a circuit specifically designed for this purpose).

Apart from the correct choice of dimmer, it is essential that the correct type of fluorescent lamp and auxiliary control equipment is used.

Two types of lamp are generally available nowadays. These are commonly known as "quick-start" and "rapid start". The main difference between the two is the filament voltage. This is 8.0 volts and 3.5 volts respectively.

The 'quick-start lamp is now going out of fashion, and almost all lamps sold today are 'rapid-start'. Any new dimming installation should be planned around the 'rapid-start' type.

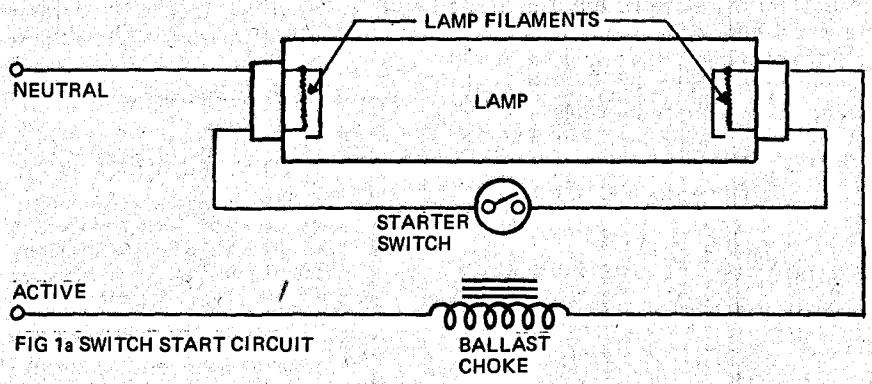


FIG 1a SWITCH START CIRCUIT

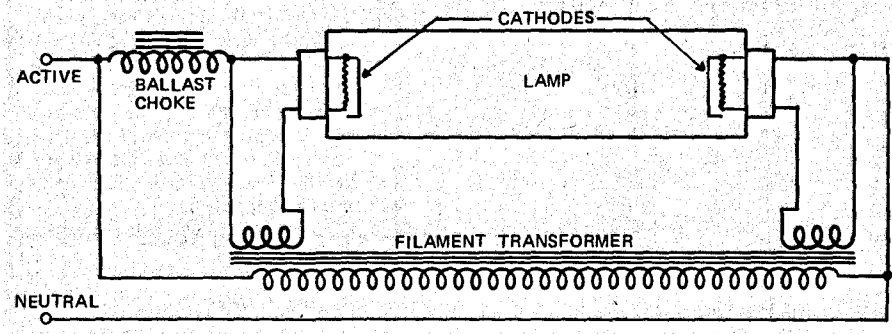


FIG. 1b STARTERLESS CIRCUIT

STARTING CIRCUITS

Figs. 1a and 1b show the two most commonly used fluorescent lamp circuits. Figure 1a shows the 'Switch-start' circuit. This is the type most commonly found in existing domestic installations. It is used because it is simple and cheap.

The second circuit (Fig. 1b) shows the 'Starterless' system. This is used in commercial installations because it has several operating advantages that offset the higher initial cost.

The fluorescent lamp is basically a mercury discharge lamp in which short wavelength ultra-violet radiation produced by the discharge, is converted to visible light by a phosphor coating on the inner walls of the tube.

Like most other gas discharge devices, fluorescent tubes have a negative resistance characteristic; that is, unless the current is limited by some means, the lamp will draw all the current available until either the lamp or the supply source fails.

A resistor could, of course, be used to limit this current, but this would result in excessive power losses. Hence an inductance is used, because at least in theory, this will limit the current without in itself dissipating any power. In practice some power is wasted due to copper and iron losses.

In the 'Switch-start' circuit, a thermal starter switch closes for a short time when power is first applied. This allows ac power to heat the filaments. When the switch opens, the ballast choke gives an inductive 'kick' and the lamp starts. This is a brute force method. Each start strips emissive material from the cathodes,

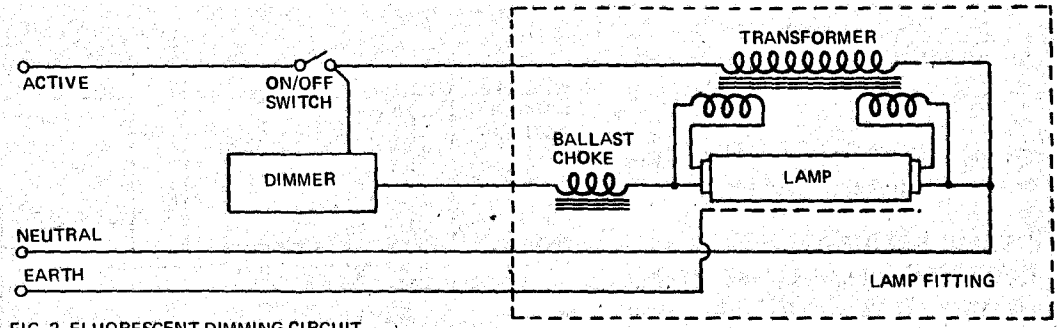


FIG. 2. FLUORESCENT DIMMING CIRCUIT

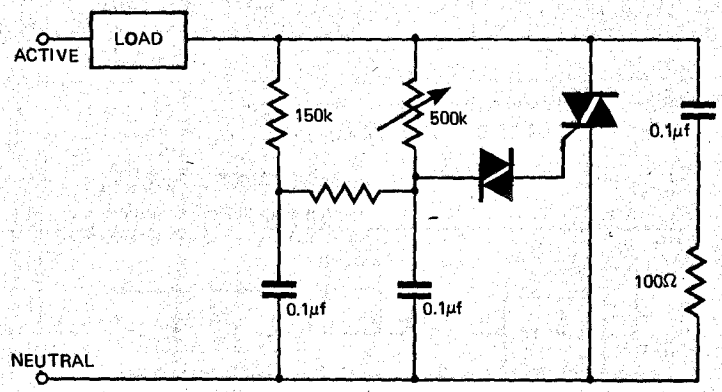


FIG. 3. TYPICAL DIMMER FOR DOMESTIC INSTALLATIONS

until finally the lamp fails to start. The starter switch, nevertheless keeps on trying to start the lamp and the familiar clacking sound is the result.

"The "Starterless' circuit (Fig. 1b) is a better system. Instead of the starter switch, a filament transformer is used to supply continuous heater power, thus the lamp starts noiselessly, without such a drastic stripping of the cathodes. Thus lamps in starterless circuits have a longer life than those in switch-start circuits.

Neither of these circuits can be dimmed satisfactorily without modification. In fact, it would not be possible to dim the lamps by more than 50% without the lamps extinguishing and falling to restart.

THE MODIFICATIONS REQUIRED

Fortunately quite a simple modification to the starterless circuit considerably improves operation. All that is necessary is to supply the filament transformer directly from the mains, whilst the dimmer controls the current through the ballast choke and lamp. (Fig. 2).

Thus to dim existing fluorescent lights the following changes must be made:—

SWITCH-START CIRCUITS

(1) Remove and discard the starter switch.
(2) Install a filament transformer. Make sure that the transformer has the correct filament voltage for the type of tubes being used. Filament transformers for this purpose can be ordered through most electrical wholesalers.
(3) Install an additional active lead from the fitting back to the active side of the dimmer.
(4) Make sure that the fitting is properly earthed. A good earth is essential for reliable starting.

At first it seems a simple matter to convert a starterless circuit to dimming operation.

However, there is a snag and that is that the majority of starterless fittings use a "Rapid-Start" or "Quick-Start" ballast. This consists of the limiting choke and filament transformer contained in the one can, and only one active lead is brought out for both.

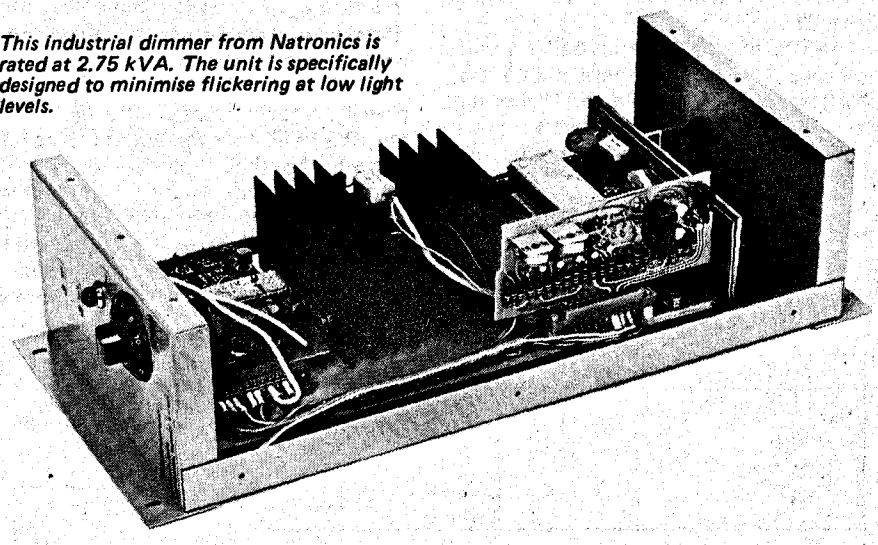
It is practically impossible to cut open the ballast and separate these leads. The complete assembly must be discarded and a separate switch-start ballast and filament transformer installed. Similar additional wiring is as for the switch-start conversion.

The circuit of a typical commercial dimmer is shown in Fig. 3. Up to a point this circuit is suitable for dimming both incandescent and fluorescent lamps, but at low illumination levels the inductive nature of a fluorescent load will cause this circuit to hunt and the lamp to flicker. This flickering may be reduced by installing a resistance in parallel with the fluorescent load. This can be either a 1500-2500 ohms, 50 Watt resistor, or an incandescent globe. If an incandescent globe is used, the size should be related to the VA rating of the fluorescent loading on the dimmer, as shown below:—

dimmer loading	incandescent load
100 VA	15 Watts
300 VA	25 Watts
700 VA	40 Watts
1000 VA	60 Watts

Only one resistor or lamp will be required across each dimmer. This will reduce the flickering to some extent, but as most of the low level flickering is caused by assymetrical triggering of the Triac (caused by lack of symmetry in the triggering diode) it is better to use a dimmer that has been specifically designed for use with fluorescent

This industrial dimmer from Natronics is rated at 2.75 kVA. The unit is specifically designed to minimise flickering at low light levels.



FLUORESCENT LAMP DIMMING

lighting — as has the one described in the constructional project elsewhere in this issue.

DIMMER LOADINGS

Solid-state dimmers are rugged devices. They can be used continuously at their maximum designed rating but they cannot withstand any appreciable overload. This may be taken into account when calculating dimmer loading

With incandescent lamps, calculating the load is a simple operation. A 100 Watt lamp consumes 100 Watts. Six 100 Watt lamps consume 600 Watts.

But with fluorescent lamps it is not that simple, for the ballast choke causes the fluorescent circuit to have a lagging power factor. Loading must, therefore, be based on the volt/amps (VA) rating of the lamp, *not* the wattage.

The VA ratings of fluorescent tubes are given in Table 1.

Thus, as can be seen, a dimmer rated for a 500 watt load, will in fact be suitable for only five 40 watt fluorescent tubes, and not 12 as might be expected.

A separate ballast and filament transformer must, of course, be used for each lamp.

Preferably all lamps on one dimmer circuit should be of similar wattage. This is because the light output of different lamps does not decrease at the same rate for similar dimmer settings.

The variation in dimming characteristics is proportional to the ratio of lamp volt/amps to lamp wattage. If, for example, a 20 watt lamp must be paralleled with a 40 watt lamp, then a special auto-transformer type of ballast must be used to make the volt/amps:wattage ratio of the 20 watt lamp equal the 40 watt lamp. (Fig. 4).

The use of these special ballasts will improve tracking, but there will be less starting voltage available and flickering at low illumination levels may increase. Multiple dimming of dissimilar lamps should, therefore, be avoided wherever possible.

POWER FACTOR

An undimmed 40 watt lamp has an uncorrected power factor of 0.4 lagging. This may be brought back to about 0.85 lagging by adding a 3.5 uF capacitor in parallel with the lamp circuit.

In areas where frequency injection is used to control off-peak water heaters, a blocking inductor must also be fitted to prevent the capacitor bypassing the injected tone (which is usually within the frequency range 750 — 1050 Hz).

Power factor capacitors must *never* be fitted across the output of the dimmer because the surge current drawn by the capacitor will exceed the rating of the Triac or SCR and destroy it. The capacitor must, therefore be located on the mains side of the dimmer. This can be achieved by wiring the capacitor (and blocking inductor, if used) between the filament transformer active and neutral — as shown in Fig. 5.

A dimming circuit that has been power factor corrected to a factor of, say, 0.8, will only remain at 0.8 at full output. As the dimmer reduces the lamp current, the inductive component of the line current is reduced, but the capacitive component remains the same. The nett result is that the power factor, as the dimmer level is reduced, moves towards unity and eventually becomes leading. Some councils get very uptight about this, but the power factor becomes leading only at very low power levels, and dimming circuits are very rarely operated at these levels for extended periods.

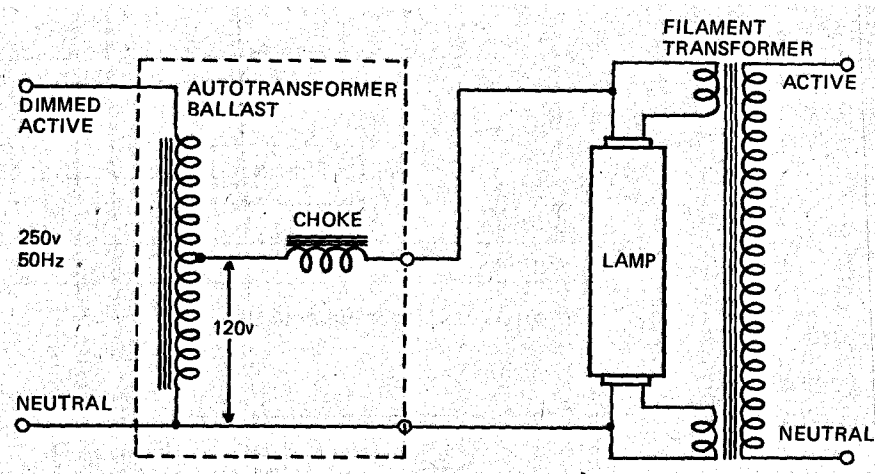


FIG. 4. AUTO TRANSFORMER DIMMING CIRCUIT USED TO MATCH TRACKING OF DIFFERING LAMPS

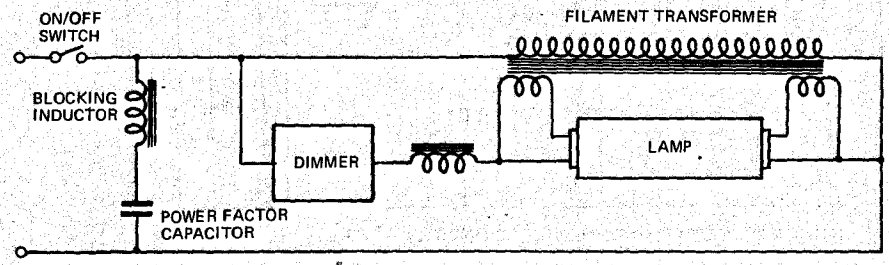


FIG. 5. FITTING OF P.F. CAPACITORS TO DIMMING FITTING

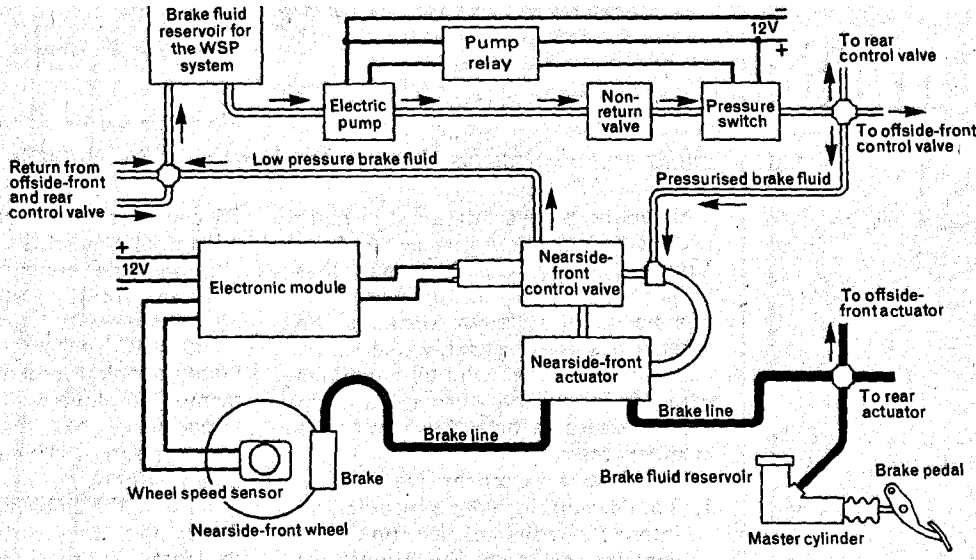
VERY LOW LIGHT LEVELS

Where very low light levels are required, the following points should be noted:—

1. Lamps should be pre-aged for at least 100 hours and then selected for minimum flickering.
2. 'Warmwhite' (low colour temperature) lamps behave very much better at low levels than 'Daylight' or other high colour temperature types.
3. Heaters may need to be used at very low light levels as low wall temperatures will cause unstable arc operation.
4. High loaded lamps, such as the two foot 20 Watt, or five foot 65/80 Watt, operate better at low levels than low loaded lamps such as the four foot 40 Watt types. In extremes the tube should be protected from air currents and, if possible, a heater should be used.
5. Tubes should be operated horizontally.
6. Low loss choke type ballasts should be used, rather than auto-transformer types, for minimum flicker. ●

Tube Indicated Wattage	VA Rating
15, 20 or 30	90
40	100
65	180
80	210

Table I. This table shows the VA rating of various size fluorescent tubes.



ANTI-SKID BRAKING

Latest electronic wheel anti-locking system should reduce road accidents.

ALTHOUGH braking system performance and tyre adhesion characteristics have improved substantially over the last 10 years, skidding due to wheel-locking (arising from too fierce application of the brakes) continue to be a factor in a large percentage of road accidents.

And whilst advances in the understanding of the stability and controllability of vehicles has led to better handling characteristics and improved steering geometries, the frictional characteristics of the road surface – especially under wet or icy conditions – remain probably the greatest potential hazard to most drivers.

In an emergency the unskilled driver's natural inclination is to apply maximum foot pressure onto the brake pedal. Normally, and especially under adverse weather or road surface conditions, this leads to wheel-locking and either skidding of the back of the vehicle, or loss of steering control, or both.

A number of companies are actively developing systems that detect incipient wheel locking and release brake pressure accordingly.

An electro-hydraulic method of sensing wheel locking was foreseen by A. F. Poynton of Britain's Genéral Electric Company in 1960, and the Dunlop Maxaret system, which uses flywheels and valves to operate a full power system, has been used to prevent wheel locking on aircraft for a number of years. Whilst the Maxaret system has been installed in aircraft for some years it has always been considered too complex and expensive for cars.

But now an elegant and cheap electronic – hydraulic system has been developed by the Girling division of Joseph Lucas. The system – named the Girling-Lucas Wheel Slide Protection System (WSP) is adaptable to all ordinary hydrostatic hydraulic brake systems. It provides individual sensing control at each wheel.

The wheel deceleration signal is derived from a magnetic pick-up and toothed disc mounted behind each brake drum or disc.

As the toothed disc revolves, (at the speed of the road wheel to which it is attached) a train of pulses are produced. These pulses, which have a frequency proportionate to wheel speed, are then amplified and then fed into a differentiating circuit that closes a switch if a pulse rate change at a rate that indicates a wheel deceleration greater than 1.3G. (This is the level at which incipient wheel locking takes place).

A very simple and ingenious method has been developed to enable the WSP system to be used in conjunction with standard hydraulic brake systems.

This has been achieved by using a hydraulic ring circuit pressurized to 300 psi. The purpose of this high pressure circuit is to close a control valve inserted between the master cylinder and each individual wheel cylinder. This valve which is solenoid actuated, is controlled by signals from the electronic speed sensing circuit.

When a wheel exceeds the 1.3G deceleration level, the solenoid is energised and the control valve cuts off the brake line pressure to that particular wheel. At the same time a port is opened on the wheel-cylinder side of the control valve and admits a small quantity of brake fluid into a cavity formed in the control valve – reducing the pressure at the wheel-cylinder – and thus reducing deceleration of that wheel.

As soon as the wheel deceleration is reduced (due to this reduction of hydraulic pressure) the actuating solenoid is de-energised and hydraulic pressures restored.

The complete cycle is repeated ten times a second until the vehicle stops or the driver reduces brake pedal pressure below the wheel-locking point.

The system is extremely effective and braking distances on wet and greasy roads are dramatically reduced.

This system is still experimental but it is believed that it may be put into production in the near future. ●

Youth Radio Clubs

Young people throughout Australia gain their knowledge of radio and electronics through the Youth Radio Clubs Scheme.

All young people interested in radio and electronics should be aware of the Youth Radio Clubs Scheme, that originated in NSW in 1962 and now operates in all States of Australia. The scheme has grown steadily due to the dedication of the voluntary workers who administer the scheme and in no small measure to the enthusiasm of the members themselves.

Objectives of the scheme are:

1. To develop in young people, an interest in radio and electronics as a vocation, or as a hobby throughout life.
2. To provide school students with a hobby that will reinforce their school activities in science and mathematics, (the YRCS Senior Certificate is accepted as a Leaving Certificate subject in Victoria).
3. To assist youth clubs by providing ready-made programmes of activities.
4. To co-operate with schools, youth organisations and other clubs to foster an interest in radio and electronics.
5. To give encouragement and recognition to members who show theoretical and practical ability, the YRCS awards a series of Radio Proficiency Certificates graded at six levels; these are: 1. Elementary, 2. Junior, 3. Intermediate, 4. Senior, 5. Advanced, 6. Instructor.

Comprehensive notes for each of these examination courses cost about 75 cents per Certificate. Courses are open to all boys and girls over 10 years old, and the organisation is strictly non-political, sectarian, and non-commercial.

The YRCS scheme has value when young people eventually seek jobs, for many employers understand the importance of the scheme and recognise the Certificate Examinations.

Many of the clubs have Amateur Call Signs and this not only provides students with amateur radio experience but allows them to discuss many technical and other matters with people in countries all over the world.

Full details of the Youth Radio Club Scheme can be obtained from the YRCS Supervisor in each State.

N.S.W. J. Flynn, 30 Sharp St., Belmore, NSW. 2192.

Vic. K. J. McLachlan, P.O. Box 39, Mooroolbark, Vic. 3138.

S.A. A. Dunn, 18 Mackinlay St., Elizabeth Down, S.A. 5113.

Qld. R. A. Everingham, 30 Hunter St., Everton Park, Brisbane. 4053.

W.A. L. Jessop, P.O. Box N1002, GPO Perth, WA. 6001.

Tas. R. Emmett, C/- Kings Meadow High School, Gay St., Kings Meadow, Tas. 7250.

The YRCS also has a correspondence section for young people living in outlying areas. The address of this section is — YRCS, 34 Flower St., Ferntree Gully, Vic. 3156.

Presentation of Certificates

Left to right: K.J. McLachlan Victorian Supervisor. Cr. F. Kennedy Mayor of Croydon. J. Leddin St. Johns Radio Club. Honours Jnr. Cert. Brother F. Whittan, Leader St. Johns Radio Club. K. Baker, St. Johns Radio Club, Honours Jnr. Cert. M. Surace, St. Johns Radio Club, Cred. Elementary Cert. I. Whitehead, Croydon High School Radio Club, Honours Intermediate Cert. J. Spapens, Croydon High School Radio Club, Club Leader and Instructor.

YRC-Victoria

The Youth Radio Clubs Scheme in Victoria is developing rapidly, and many new Clubs have been formed in the last three months.

Recently St. John's College Radio Club, BRAYBROOK, VK3BSJ., received their Club Registration Certificate from the Victorian Division. This Certificate was presented by the Mayor of Croydon, Cr. Frank Kennedy, along with Honours Certificates to numerous successful students. ●

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Please send me all the facts about the Wharfedale Triton . . . and the name of my nearest Simon Gray dealer.
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Introducing the most effective compact speaker system ever . . .

THE NEW 3-WAY WHARFEDALE TRITON

There's no doubt — with three scientifically matched speakers the new Wharfedale Triton outclasses most other speakers *twice the size* and many *twice the price*. In the Triton an 8″ bass unit is complemented by a 5″ mid-range speaker and a 1″ tweeter; these specially designed and matched speakers offer *restraint-free bass response, smooth middle frequencies* with outstanding "*presence*" and *high frequency performance* which adds the final touch to a very satisfying compact speaker system. Examine the specifications of the Wharfedale Triton closely. See how much more the Triton offers in terms of *musical promise*. Then pay a visit to your nearest Simon Gray dealer and *listen*. You'll be agreeably surprised; furthermore, as you listen, you will become more and more aware of Triton's *fatigue free sound*. This is quality you can listen to hour after hour — quality that's almost impossible to find in compact speaker systems. *Wharfedale . . . truly sound for all seasons!*

SPECIFICATIONS: Size: 21¾″ x 9¾″ x 9″. Frequency response: 55-20,000 Hz. Speaker complement: 8″ bass unit, 5″ mid-range reproducer, 1″ tweeter. Cross-over: 7 elements, 3 way. Impedance: 4-8 ohms. Power handling capacity — 18 watts R.M.S. Finishes: Oiled teak or polished walnut. Recommended list price: $159.

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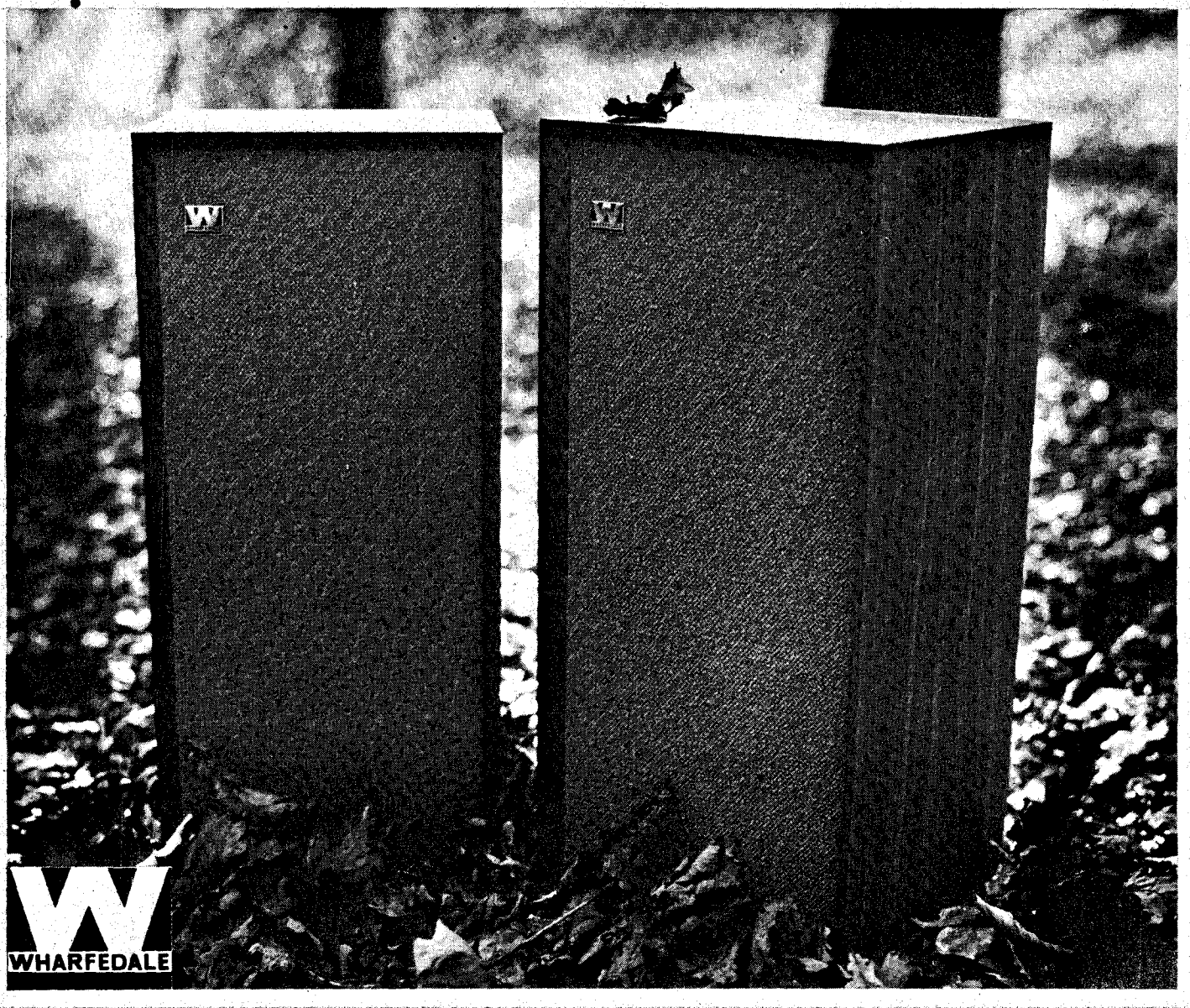


A DIMMER FOR FLUORESCENT LIGHTS

ET PROJECT 508

This 700VA dimmer ensures smooth and almost flicker-free control of fluorescent lighting

As our article on page 44 explains, it *is* possible to dim fluorescent lights over a limited range using a dimmer that has been designed for incandescent lighting control.

But it is very probable that there will be severe flickering at low light levels.

Although this flickering can be reduced by various techniques, it is primarily caused by asymmetrical current flow in the tube, i.e. current in one half cycle is greater than current in the other half cycle, and unlike the 100 Hz flicker that is present at all times, asymmetry introduces a 50 Hz component that the eye can follow.

The most commonly used method of light dimming today is phase control, (described in detail in our article A Practical Guide to Triacs – July 1971).

In this method the effective power input to the lamp is adjusted by varying the proportion of each half-cycle of the mains wave-form that is supplied to the load.

Most domestic dimmers sold today use this operating principle and have a circuit basically similar to that shown in Fig. 1.

This circuit will control fluorescent loads fairly well providing the triggering diode is selected for symmetrical operation, but triggering diodes are not generally sold this way and 10% asymmetry is not uncommon. What this means *is* that the diode will trigger on one half-cycle at say, 32 Volts and on the next half-cycle at 29.5 Volts. And so at low light levels the diode may trigger the Triac only on alternate half-cycles. This causes flicker.

The same asymmetrical operation will also occur with incandescent loads, but due to the thermal inertia of the filament, the visual effect is much less noticeable.

The dimmer shown in this project overcomes the problem of asymmetry. It provides as nearly as possible an ideal and symmetrical waveform for fluorescent tubes.

Some flickering may still occur at very low light levels because the fluorescent tubes themselves may not be perfectly symmetrical. (The only way to achieve totally flicker-free operation is to use a variable frequency supply. The cost of this method would be enormous even if the PMG were to agree to its use).

The maximum loading that can be placed on the dimmer is 700VA. Table 1 shows how the VA rating is calculated. It is also possible to use a combination of both fluorescent tubes and incandescent lamps and in this case the VA rating of the incandescent lamp is simply its normal wattage ie. 100 Watts equals 100VA.

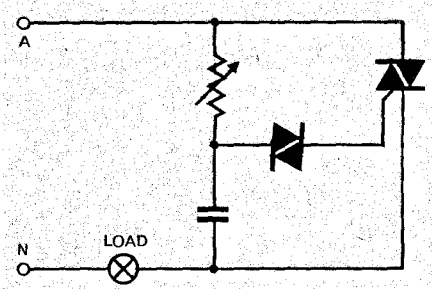


Fig. 1. Many commercially available light dimmers use circuits similar to this.

CONSTRUCTING THE DIMMER

Construction is fairly simple, but remember that this unit is connected to the main 240 Volt supply and follow our instructions carefully – especially those sections concerning insulation.

The circuit diagram of the complete unit is shown in Fig. 2, and the foil pattern of the printed circuit board in Fig. 3. Metalwork drawings are shown in Fig. 4 and the complete assembly drawing in Fig. 5.

1. Mount the potentiometers on the chassis and cut the shafts to the required length. The minimum adjustment potentiometer should be cut short and slotted so that it may be adjusted with a screwdriver.

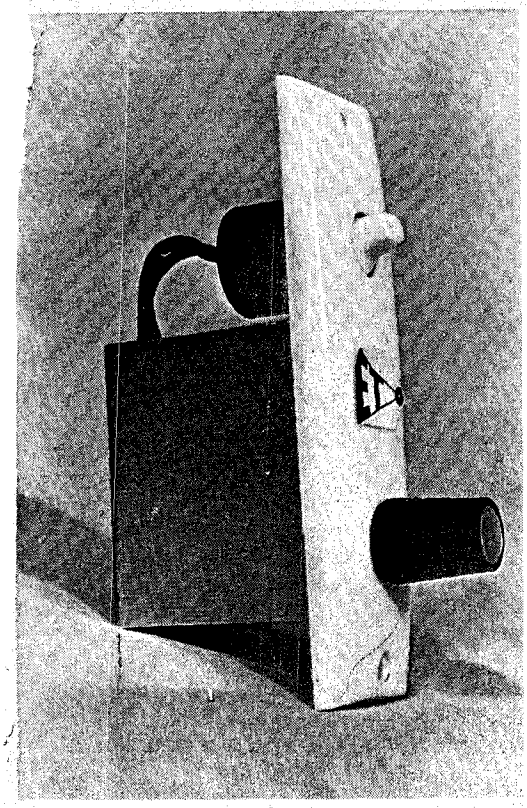
Insulated wires should now be soldered onto the respective terminals of the potentiometers ready for later attachment to the printed circuit board.

Glue a piece of insulating material 0.025" – 0.035" thick and ¾" diameter to the back of the potentiometers.

2. Before mounting the Triac a lead must be soldered onto the top edge (i.e. nearest the terminals). When doing this, place the Triac on a piece of copper or aluminium to act as a heat sink, and use the minimum heat required to make a good joint.

Tube Indicated Wattage	VA Rating
15, 20 or 30	90
40	100
65	180
80	210

Table 1. This table shows the VA rating of various size fluorescent tubes.



3. Cut a circle of mica ¾" diameter and 0.002" to 0.005" thick. This may be cut out of a T03 washer if required. Glue this mica washer to the side of the chassis, using epoxy glue. Then glue the Triac to the centre of the mica. The epoxy glue should extend completely over the top surface of the mica to prevent the mica splitting. The new 'five minute' epoxy glue is ideal for this purpose.

4. The rf choke (L1) should now be wound following the details shown in Fig. 6. Then wind the pulse transformer as shown in Fig. 7. Care must be taken with the insulation — there is 240 Volts ac between the primary and secondary winding on this transformer.

5. The components can now be soldered onto the printed circuit board. Locate transistor Q2 so that it is about 3/16" off the board and transformer T1 so that it is about 1/8" off the board. Capacitor C1 is mounted flat on top of the diodes. Fig. 8 shows the location of all components.

6. Glue the choke L1 on top of the 50k potentiometer, and connect one lead to the 'cathode' of the Triac (larger of the two terminals).

7. Connect the lead, which is soldered to the case of the triac, and the second lead from the choke to the appropriate places on the printed circuit board.

8. The printed circuit board should now be mounted on the chassis using 6BA nuts and bolts and 3/16" insulating spacers. Make sure that the board is reasonably level and is not touching the Triac or the chassis.

9. The leads from the secondary of the pulse transformer should now be twisted together. One lead should be connected to the Triac gate and the second lead connected to the Triac 'cathode'.

10. Connect the leads from the potentiometers to their respective locations on the printed circuit board.

11. Insert two short lengths of 23/0076 240 Volt insulated wire through the slot in the chassis and solder one end of each to the appropriate solder lands on the printed circuit board.

12. Place a piece of insulating material over the back of the printed circuit board and fit the cover temporarily in position. When doing this make sure that no bare wires can touch any metal. The dimmer is now ready for testing.

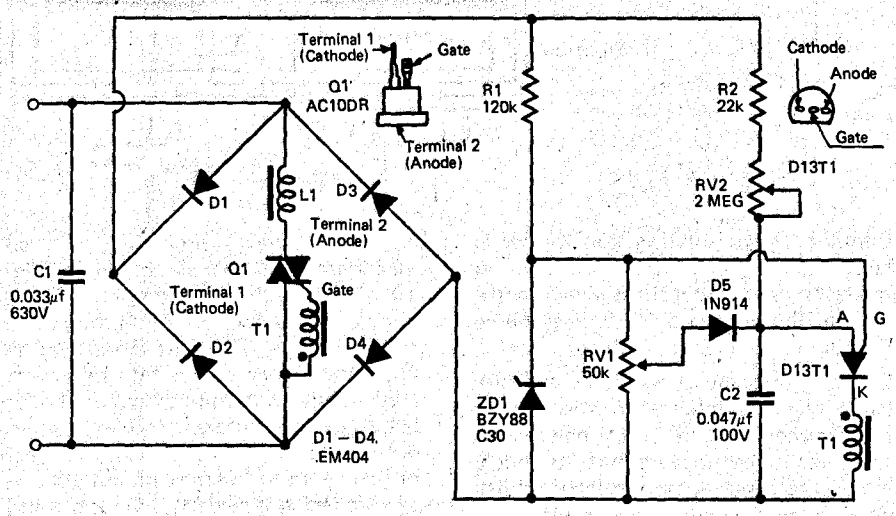


Fig. 2. Complete circuit diagram of the ET 508 light dimmer.

PARTS LIST
FLUORESCENT DIMMER ET 508

C1 — capacitor 0.033 uF, 630 Volt, Philips type 2222 342 60 333.
C2 — capacitor 0.047 uF, 100 Volt, Elna, greencap.
D1-D4 diodes EM 404.
D5 — diode 1N 914
ZD1 — zener diode BZY 88 C30.
Q1 — Triac type AC 10 DR
Q2 — programmable unijunction transistor type D13T1
RV1 — miniature potentiometer 50k linear type CTS 200 or similar.
RV2 — miniature potentiometer 2 Megohm, type CTS 200 or similar.
L1 — choke (see text) wound on ferrite plate 7/8" long x 19mm x 3.8mm.
T1 — pulse transformer (see text) wound on Neosid core type .159x.375/2xB6/F14. (Neosid Pty. Ltd., 23 Percival St., Lilyfield, NSW.)
R1 — resistor 120k, ½ Watt, 5%.
R2 — resistor 22k, ½ Watt, 5%.
One 3 way switch plate HPM 553, one switch mechanism HPM 550, insulation material 0.025" – 0.035" thick, mica sheet, 6BA x ½" bolts and nuts, 3/16" spacers, insulated control knob, wire, epoxy glue etc. Metal work, printed circuit board ET 011.

A DIMMER FOR FLUORESCENT LIGHTS

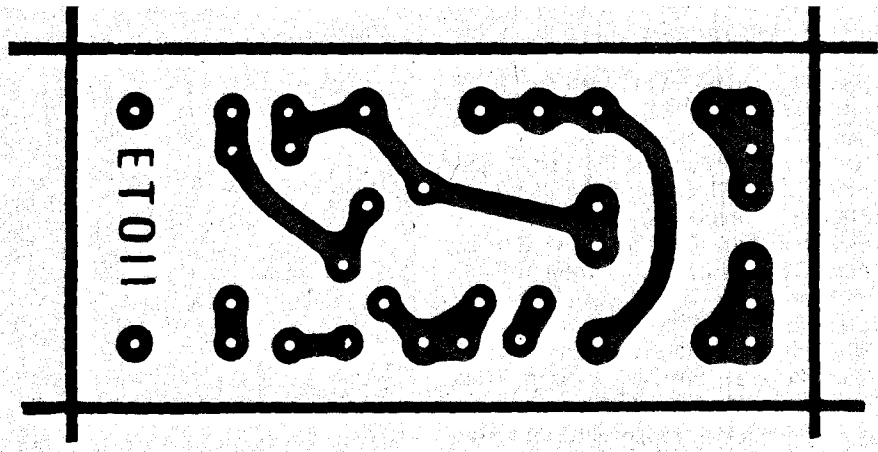


Fig. 3. Foil pattern of the printed circuit board. Note that this is shown here exactly twice full size.

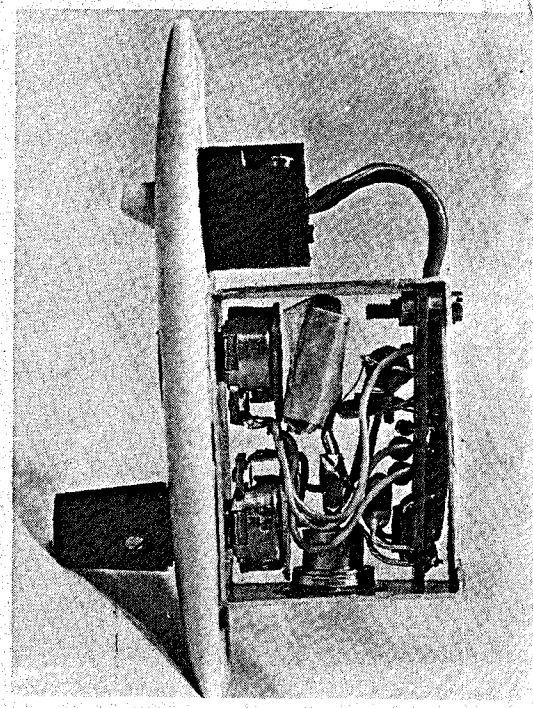


Fig. 4. Details of metalwork.

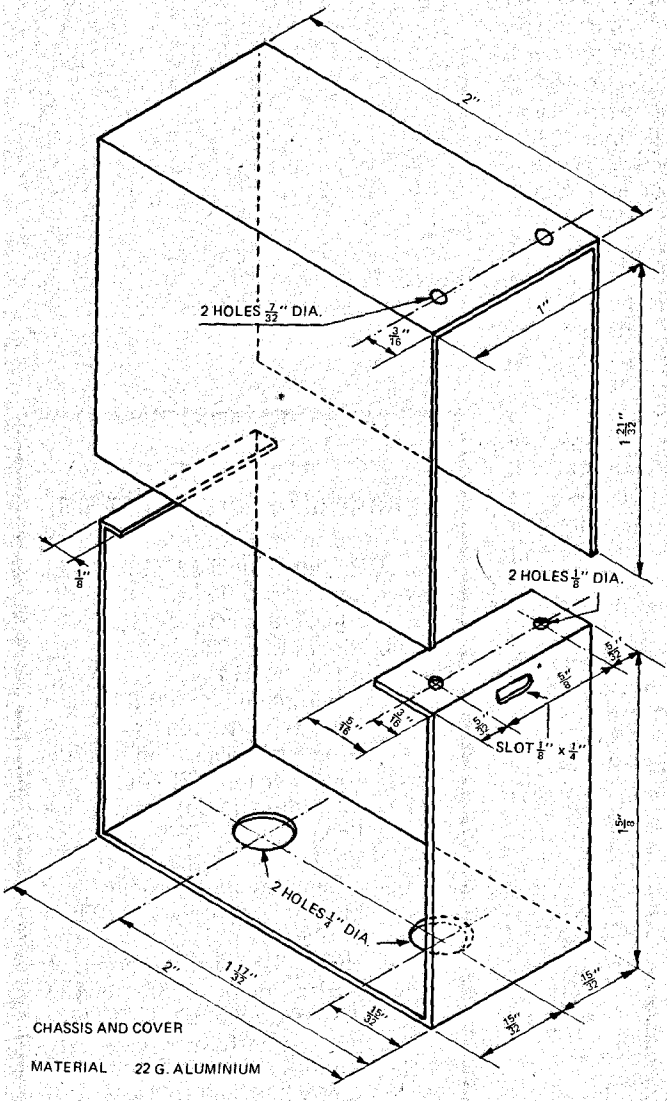
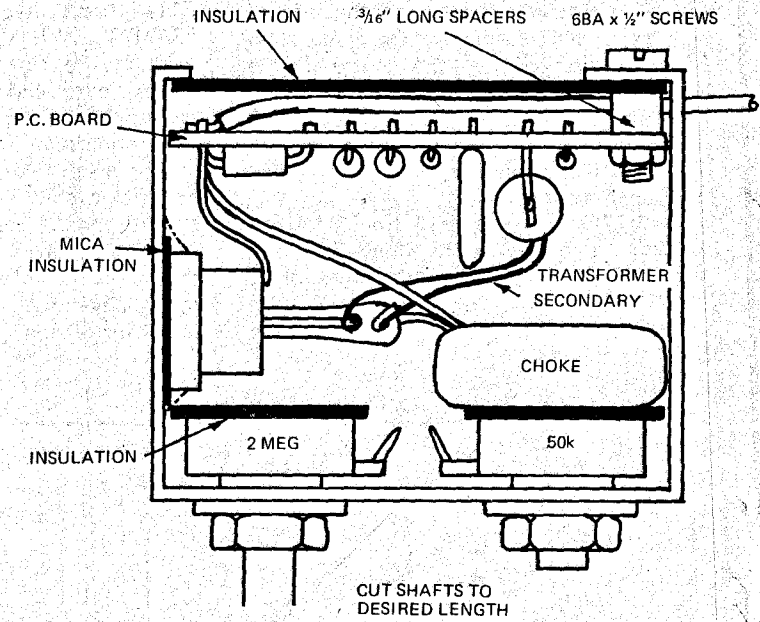


Fig. 5. How the unit is assembled.



TESTING

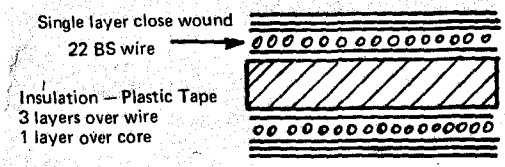
If a Megger is available, check the insulation by twisting together the two leads from the dimmer and testing between these two leads and the metal chassis. (Fig. 9). A reading of several Megohms should be obtained.

If a Megger is not available then check by using the circuit shown in Fig. 10. The lights should not glow at all — if they do then there is an insulation breakdown within the dimmer. If an isolating transformer is not available the same test can be made by connecting the mains directly to the dimmer via a 15 Watt globe as shown in Fig. 11.

If the test must be done without using an isolating transformer, place the dimmer on a thick dry newspaper and take extreme care not to touch either the dimmer or the leads whilst power is connected to the circuit.

Having completed the insulation test, connect the dimmer to an incandescent globe as shown in Fig. 12. Turn both potentiometers fully anticlockwise and switch on the power to the dimmer. The light should not be on, now turn up the minimum adjustment potentiometer until the light just glows. The main potentiometer should now control brilliance up to the maximum level.

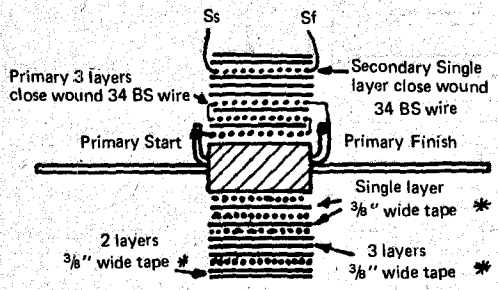
If flickering is evident, switch off and reverse the connections from the pulse transformer to the Triac.



CHOKE

CORE 7/8" LONG PIECE
OF 19 x 3.8mm
FERRITE

Fig. 6. How to wind the choke.



PULSE TRANSFORMER
CORE-NEOSID TYPE
.159 x .375/2 x B6/F14

* 3/8" wide cellulose tape recommended

Fig. 7. Details of the pulse transformer – follow the construction exactly as shown.

FIG. 9

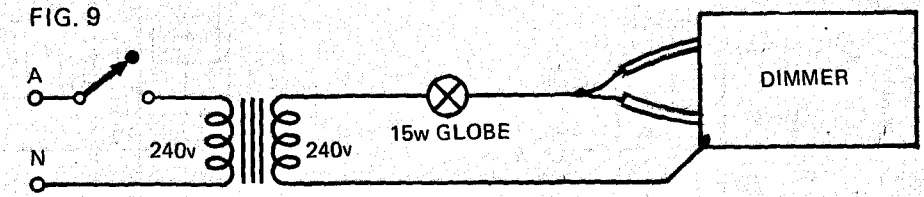


FIG. 10

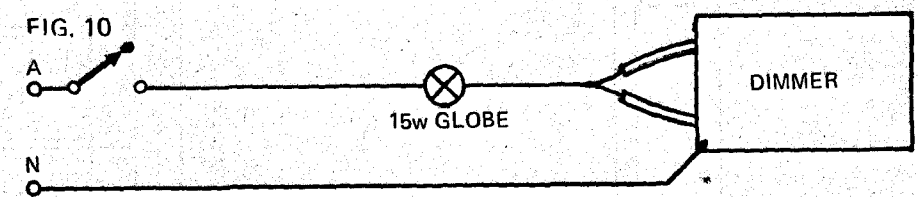


FIG. 11

The unit may now be glued to the front plate and the cover glued onto the chassis (use Araldite or other epoxy glue). Connect the two wires from the dimmer to the switch.

INSTALLATION

Any modifications to the house wiring must be carried out by a licenced electrician and the following notes are intended for guidance only:-

If the dimmer is to be used solely with incandescent loads, all that is necessary is to connect the dimmer in place of the existing wall switch.

If fluorescent lamps are to be used, first read the article on fluorescent lamp dimming (beginning on page 44 of this issue), and then refer to Fig. 13. This is a composite drawing showing the wiring required for various combinations of fluorescent lamps.

A single fluorescent lamp would be connected as shown in Fig. 13a. If twin tubes are used then Fig. 13b would be applicable. If both single and twin fittings are to be paralleled then use Figs. 13a and 13b.

There may be occasions when it is

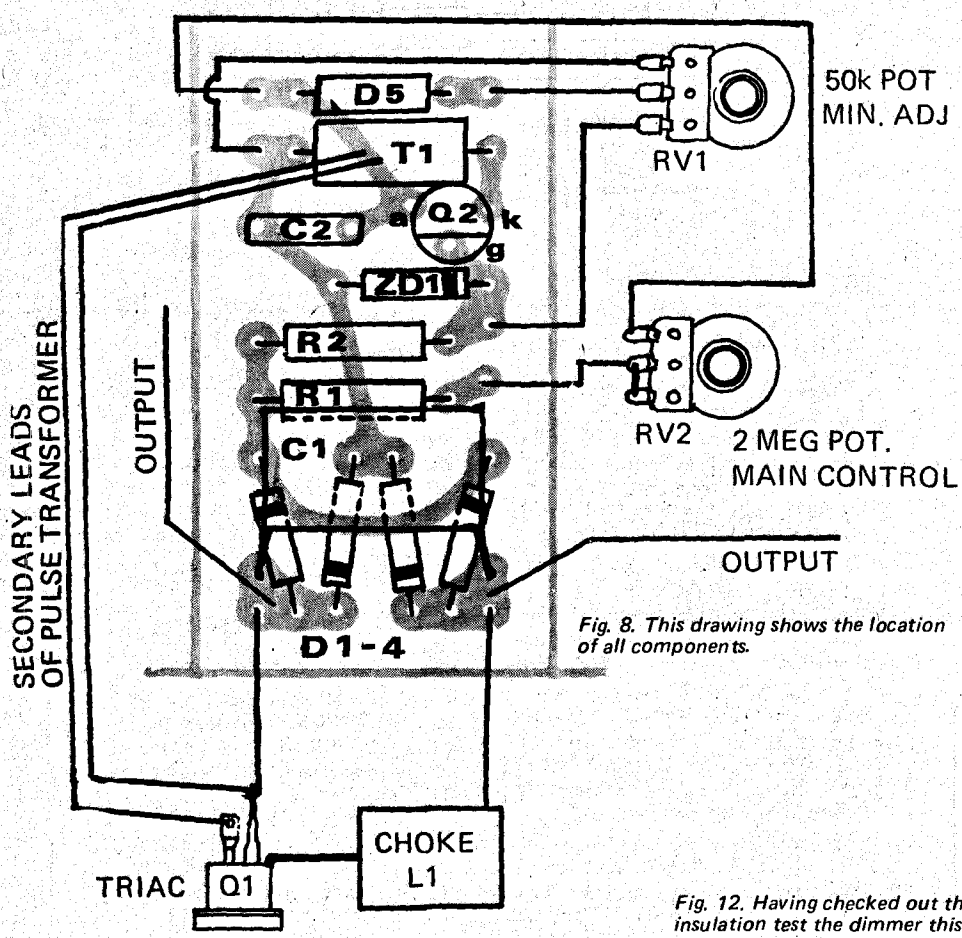


Fig. 8. This drawing shows the location of all components.

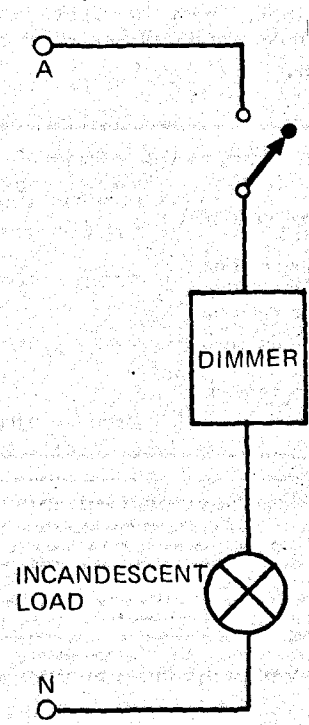


Fig. 12. Having checked out the insulation test the dimmer this way.

A DIMMER FOR FLUORESCENT LIGHTS

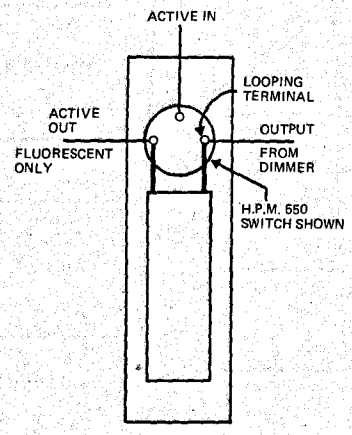


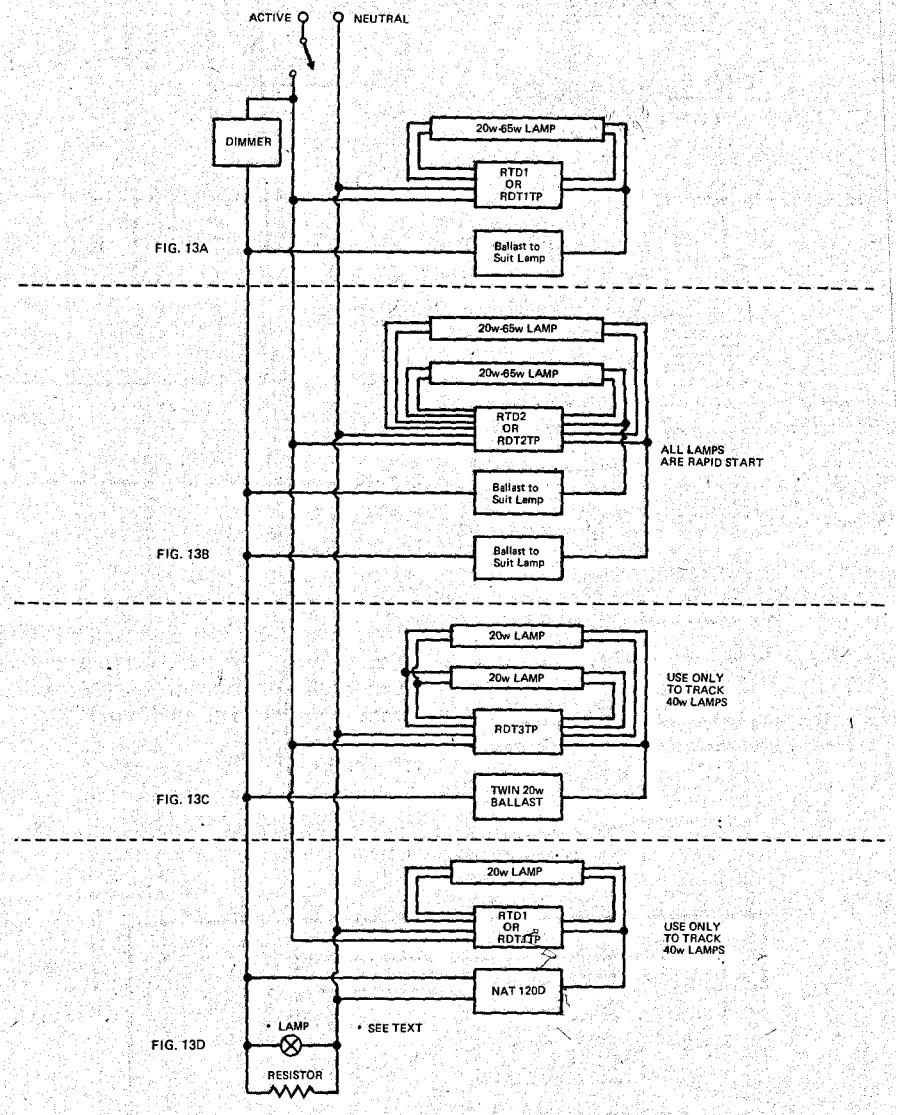
Fig. 14. This shows how the dimmer is connected to the HPM 550 switch.

necessary to parallel a twin 20 Watt fitting and a single 40 Watt fitting – in this case use Figs. 13a and 13c.

No matter what combination of fluorescent tubes are used it will always be necessary to install the resistor (or incandescent globe) as shown in Fig. 13 and explained in the fluorescent dimming article.

Again, as explained in the fluorescent dimming article, filament transformers must be used. The correct type of transformer for each application is shown in Table 2.

Filament transformers may be ordered through your parts supplier or through an electrical wholesaler. Our experience is that most companies do not hold them in stock but will willingly obtain them against a firm order.



FILAMENT TRANSFORMERS

	NAT-RONICS	FER-GUSON
Single rapid start tube	RTD1	RDT1TP
Twin rapid start tubes	RTD2	RDT2TP
Twin rapid start tubes 20 Watt (to track 40 Watt)	—	RDT3TP
Single 20 Watt to track 40 Watt. (use NAT 120D ballast)	RTD1	RDT1TP

HOW IT WORKS

The power circuit consists of C1, L1, and Q1. Q1 is a Triac, which when triggered into conduction, remains so until the current through it falls to zero. The Triac is triggered at any required point during each half cycle to give a chopped sine-wave output.

The purpose of C1 and L1 is to slow down the rise time of voltage and current to reduce radio frequency interference.

The diode rectifier bridge (D1 – D4) supplies unsmoothed 240 Volts dc to the control circuit, where R1 and ZD1 supply 30 Volts to the gate of the PUT (Programmable Unijunction Transistor) Q2.

Capacitor C2 is rapidly charged via RV1 and D5 until the voltage set by RV1 is reached. Charging then continues via R2 and RV2. When the voltage across C2 exceeds the gate voltage (nominally 30 Volts) by about half a volt the PUT conducts and discharges C2 into the primary of pulse transformer T1. This causes a pulse of energy to be fed into the gate of the Triac and to trigger it into conduction.

The action of the Triac conducting removes all voltage from the control circuit until the next half cycle of the mains input waveform.

The point in each half cycle at which the PUT (and hence the Triac) is triggered is determined by the setting of RV1 and RV2. The range of the main control potentiometer RV2 may be varied by the preset potentiometer RV1, and so RV1 is used to preset the minimum light level.

This circuit ensures symmetrical firing of each half cycle of the Triac.

Make it a big sound–a good sound–the sound of tomorrow. For that you need a big loudspeaker with big performance. That's the Plessey **12U50** with 50 watts RMS power handling. It will handle any sound you can make–truthfully. The sound you make is the sound the people hear–only bigger. With the Plessey **12U50** you can let it all come out–and be sure that all the people hear it all. The 50 watt Plessey **12U50** is well known on the sound scene.

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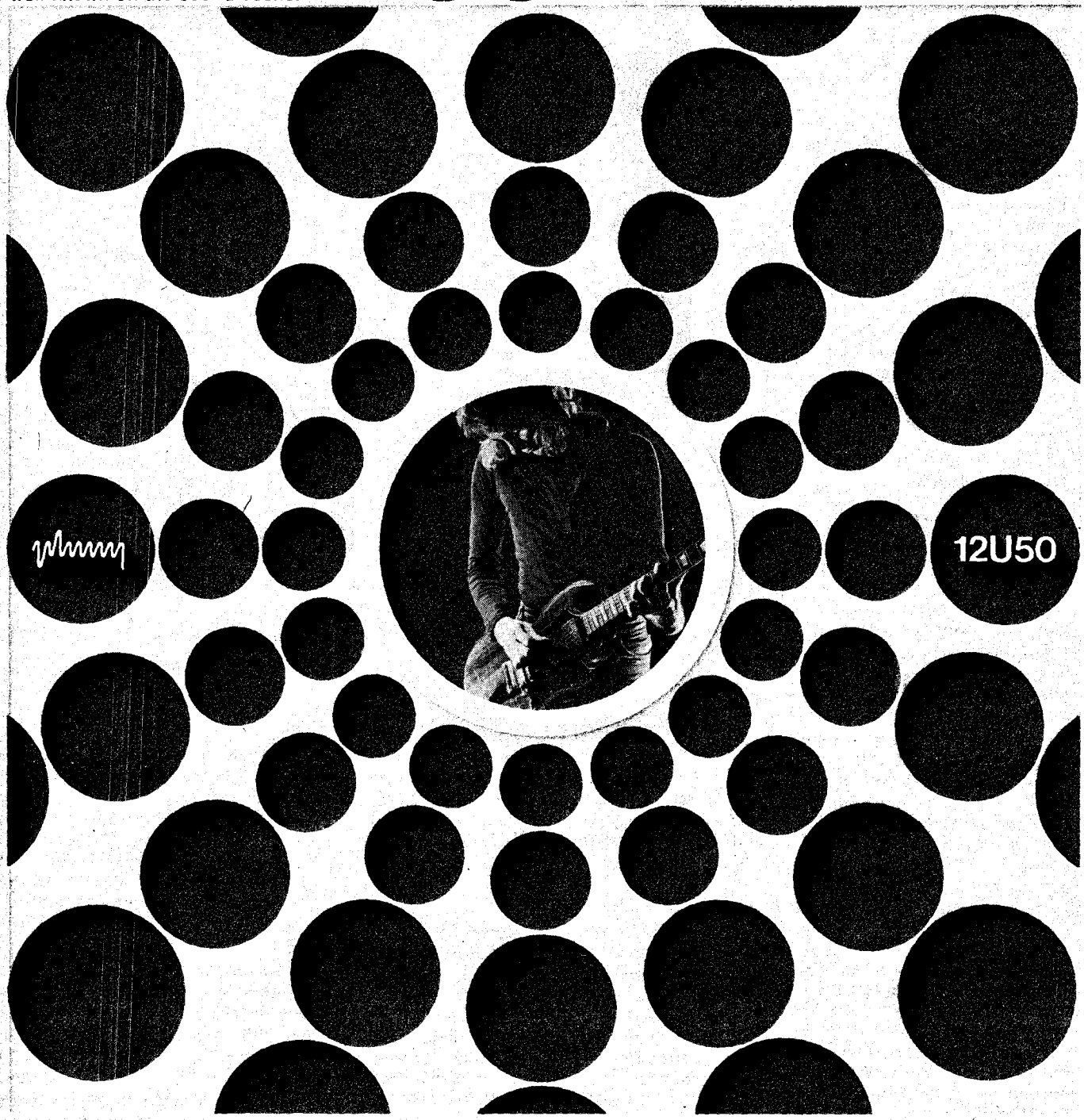

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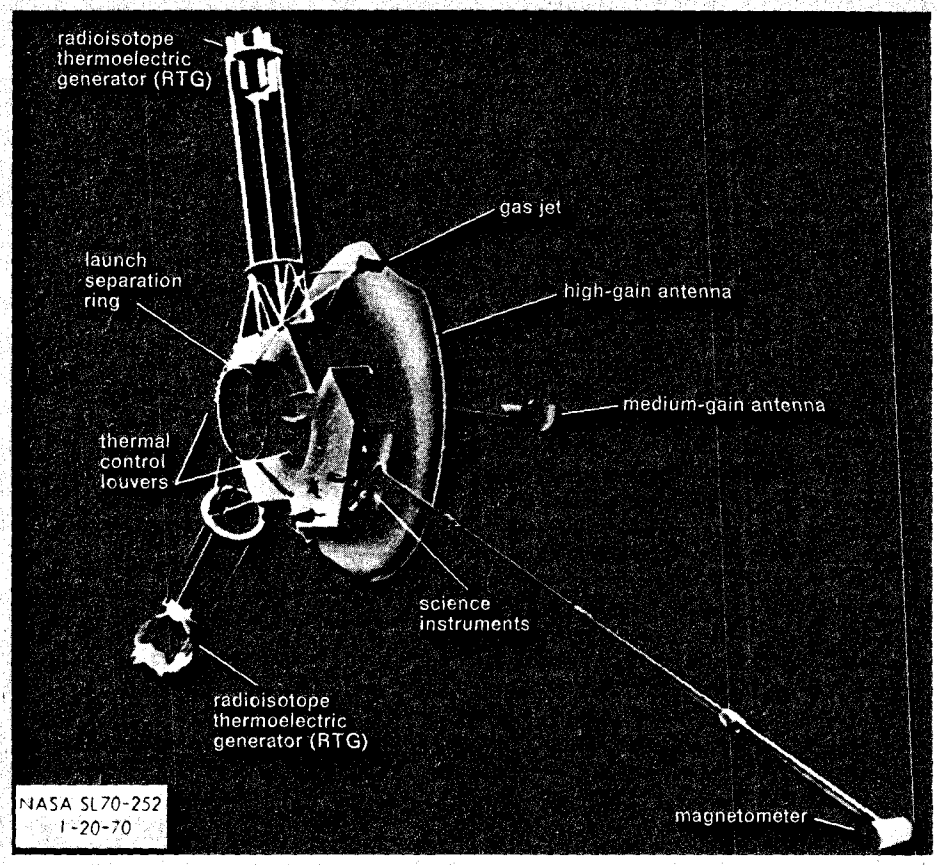
'Pioneer-F' and

MAN's first venture beyond the orbit of Mars into the outer solar system will begin with the launch of two spacecraft, *Pioneer-F* and *Pioneer-G*, in 1972 and 1973 on missions which will last about two years each.

These spacecraft will be the first to penetrate the asteroid belt and to reconnoitre the giant planet Jupiter.

After a trip of more than 800 million kilometres to Jupiter, each craft will spend about a week orbiting the planet with the period of closest approach and maximum scientific interest covering about 100 hours. Closest approach is planned to be about 160,000 km.

One goal of the mission is to assess hazards in deep space and to develop technology and operations experience for "Grand Tour" missions to the outer planets – Jupiter, Saturn, Uranus, Neptune and Pluto – planned for the late 1970s.



THE SPACECRAFT

Pioneers-F and G will be identical spacecraft weighing about 250 kg each and carrying 27 kg of scientific instruments. Each will be capable of performing 13 scientific experiments in space including photographing Jupiter with better detail than can be obtained with earth-based telescopes.

The Pioneers will be powered by four radioisotope thermoelectric generators producing a total of 120 W of electric power. The spacecraft will be stabilized in space by spinning at five revolutions-per-minute in the plane of the earth's orbit so that a three-metre diameter directional radio antenna will be pointed constantly at earth.

The spacecraft will be launched from Cape Kennedy on a direct ascent trajectory. At third stage cut-off, the Pioneers will have a velocity of about 51,840 km/h (14.4km/s) believed the fastest a man-made object will have ever travelled in space.

Unlike recent *Mariner* planetary missions, specific dates for planetary encounters by the Pioneers will not be established prior to launch. This will give greater flexibility to trajectory planning for such long missions.

LAUNCH DATES

Pioneer-F will be launched in late February or early March 1972 with the trip to Jupiter taking from 600 to 900 days. Pioneer-G will be launched in April 1973 with a comparable trip time.

EXPERIMENTS

The 13 scientific experiments will make a broad study of a number of interplanetary phenomena, possible hazards of flying through the asteroid belt, the sun's influence on interplanetary space and the penetration of galactic cosmic radiation into the solar system. They will measure hydrogen atoms, electrons, nuclei of hydrogen, helium and other elements, and the interplanetary magnetic field.

They will gather data on the heliosphere, the region of the sun's influence on the space environment; and they will look for the boundary where the heliosphere ends and galactic space begins. These studies should provide new understanding of the nature of the sun and of the effects of the heliosphere on earth.

THE ASTEROID BELT

Both spacecraft will spend six months to a year passing through the asteroid belt which circles the sun from 288 to 528 million kilometres. There may be as many as 50,000 asteroids ranging from the 768 km diameter Ceres down to bodies about 1.6 km in diameter. There are differing estimates on the number of asteroids smaller than one mile in diameter. It is

...precursors to the outer planets

estimated that there is enough material in the asteroid belt to form a small planet.

The experiments will measure the intensity and polarization of sunlight reflected from asteroids and cosmic dust (zodiacal light) to allow calculations of overall quantities of cosmic debris.

The instruments will identify the elements making up cosmic radiation and measure speed and direction of these particles within the heliosphere. They will also measure cosmic ray particles outside the heliosphere if its boundary is reached before the limits of spacecraft communications.

Near Jupiter, the Pioneers are instrumented to gather information which is still lacking about the planet. In addition, scientists will perform a celestial mechanics experiment and a radio-occultation experiment by analyzing the radio signals from the Pioneers just before and just after they pass behind the planet for about one hour as viewed from earth.

Earth-based studies of Jupiter have not yet revealed whether the surface of the giant planet is solid, liquid or gas.

JUPITER

Jupiter has a mass some 318 times that of earth and its period of rotation is about 10 hours. Scientists hope to gather clues as to why a planet with a diameter eleven times that of earth rotates more than twice as fast as earth.

Jupiter has 12 moons, including, three, Io, Ganymede and Callisto, which are larger than earth's moon.

The atmosphere is made up of hydrogen with minor amounts of methane, ammonia and probably helium. The surface is hidden by a dense layer of clouds which forms slate blue and salmon pink bands around the planet.

THE RED SPOT

Within these bands a huge red spot was detected some 300 years ago. It drifts very slowly about the same latitude but it floats relatively rapidly in longitude. In the last 200 years the

"PIONEER-F" AND "PIONEER-G" EXPERIMENT

1. **Imaging photo-polarimetry**
   - Instrument: imaging photo-polarimeter
   - Principal Investigator: Dr. Thomas Gehrels, University of Arizona
2. **Magnetic fields**
   - Instrument: helium vapour magnetometer
   - Principal Investigator: Dr. Edward J. Smith, Jet Propulsion Laboratory (JPL), Pasadena
3. **Plasma**
   - Instrument: electrostatic analyzer plasma detector
   - Principal Investigator: Dr. John H. Wolfe, NASA-Ames Research Center
4. **Charged particle composition**
   - Instrument: solid state detector
   - Principal Investigator: Dr. John A. Simpson, University of Chicago
5. **Jupiter charged particles**
   - Instrument: Geiger tube telescope
   - Principal Investigator: Dr. James A. Van Allen, University of Iowa, Ames
6. **Cosmic ray energy spectra**
   - Instrument: cosmic ray particle detector
   - Principal Investigator: Dr. Frank B. McDonald, NASA-Goddard Space Flight Center, Greenbelt, Maryland
7. **Jupiter trapped radiation**
   - Instrument: trapped radiation detector
   - Principal Investigator: Dr. R. Walker Fillius, University of California at San Diego
8. **Ultraviolet photometry**
   - Instrument: ultraviolet photometer
   - Principal Investigator: Dr. Darrell L. Judge, University of Southern California
9. **Jupiter infrared thermal structure**
   - Instrument: infrared radiometer
   - Principal Investigator: Dr. Guido Munch, California Institute of Technology
10. **Asteroid-meteoroid astronomy**
    - Instrument: 4 optical telescopes
    - Principal Investigator: Dr. Robert K. Soberman, General Electric Company
11. **Meteoroid detection**
    - Instrument: penetration cells
    - Principal Investigator: Mr. William H. Kinard, NASA-Langley Research Center, Hampton, Virginia
12. **S-band occultration**
    - Instrument: the spacecraft radio transmitter
    - Principal Investigator: Dr. Arvydas J. Kliore, JPL
13. **Celestial mechanics**
    - Instrument: the spacecraft and the Deep Space Network Doppler radar
    - Principal Investigator: Dr. John D. Anderson, JPL

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- ☐ Wide range of special and general purpose types.

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  With controlled avalanche breakdown
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- ☐ Average forward currents to 250A

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  DTL—CML—TTL (Interchangeable with SN74 Series) and MOS
- ☐ Linear
  Op Amps, Voltage Regs., Audio, Receiver types
- ☐ DIL, Flat Pack, TO-5 and TO-74/99/100
- ☐ Available to MIL specs.

Silicon Zener Diodes

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- ☐ Dissipation 400mW to 75W

Small Signal Diodes

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- ☐ Diffused junction
- ☐ Gold bonded
- ☐ Planar
- ☐ Planar Epitaxial
- ☐ Oxide Passivated

Silicon Controlled Rectifiers

- ☐ Repetitive peak off-state voltage to 1000V
- ☐ Crest working reverse voltages to 1000V
- ☐ Average forward currents to 250A
- ☐ Maximum junction temperatures to 125°C

Power Transistors

- ☐ Germanium and silicon
- ☐ Dissipation to 125 watts
- ☐ Operation to 400 MHz

Transmitting Transistors

- ☐ VHF
- ☐ UHF
- ☐ SSB

High Voltage Diodes

with controlled avalanche breakdown characteristics

- ☐ Crest working voltages to 150,000V
- ☐ Current up to 50mA

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red spot has circled the planet three times relative to other features on the rapidly rotating planet. Thus the red spot, a major feature of Jupiter which is not tied tightly to the rest of the planet, is of major scientific interest.

RADIO NOISE

Jupiter periodically emits huge surges of radio noise. It appears to have a magnetic field of its own, similar in shape to earth but far stronger, and radiation belts an estimated one million times more intense than earth's.

UNUSUAL ENERGY BALANCE

The planet is believed to be the only planet in our solar system which radiates more energy than it absorbs from the sun, current measurements indicating about twice as much. If these observations are correct, they show that Jupiter has a very dynamic interior and may have processes at work which are similar to a star's such as our sun.

Because of its great distance from earth, Jupiter is always seen from earth almost completely illuminated by sunlight so that little of a dark Jupiter can be observed.

The infrared radiometer should provide data to analyze the thermal balance of Jupiter from several different angles and establish whether the planet does have an unusual internal source of energy.

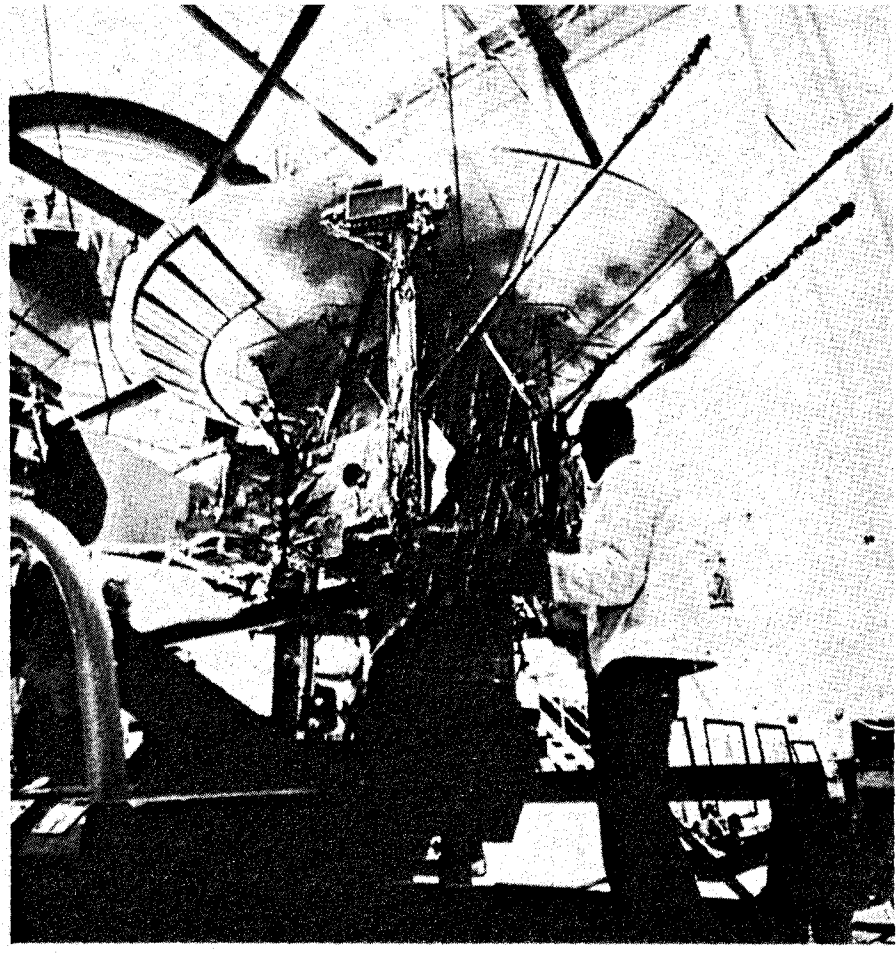
Data returned by the Pioneers during the period of closest approach to the planet will be used in studies of the composition and dynamics of the Jovian atmosphere, its cloud structure and its interaction with the interplanetary medium.

Instruments aboard the Pioneers will measure Jupiter's radiation belts and determine the strength of its magnetic field. They will try to determine the mechanism producing the planet's massive radio emissions and measure the planet's internal source of energy.

Scientists also will study Jupiter's bow shock wave created by the solar wind striking the planet's magnetic field and they will gather data on the temperature and composition of Jupiter's upper atmosphere and look for hot spots in the atmosphere. Also to be studied are possible auroral regions near both poles and levels of heat radiation from the dark side of the planet.

COMPOSITE PHOTOGRAPHY

A versatile instrument, an imaging photo-polarimeter, will take images of Jupiter which can be built into photographs of the planet. The instrument will have been used earlier in interplanetary space to measure zodiacal light and changes in light reflected by the planet indicating characteristics of Jupiter's surface.



Engineering model of the Pioneer-Jupiter spacecraft readied for thermal testing.

The camera-like device will use the spin of a Pioneer to scan the planet in narrow strips in both red and blue light. Investigators will put the elements together to make composite pictures of the planet, about one each hour. It may be possible to superimpose elements taken with the red and blue filters to make colour pictures of the planet.

It has not been determined when picture-taking will begin: it may be some days prior to closest approach so that operational techniques can be perfected for closest approach photography. It is expected that the resolution of the earliest pictures will be about that of earth-based telescopes and that the planet's image will span only about 7^{o} of the field of view of the telescope.

At closest approach (about 160,000 km) the planet's image will span about 40^{o} of the frame. Taking pictures in strips three-tenths-of-a-degree wide the camera will complete a picture every 25 to 50 minutes.

DEEP SPACE

After flying past Jupiter, the Pioneers will continue into deep space. Their trajectories will be dependent on the final aim point near Jupiter selected for each spacecraft. Pioneer-F could fly a spiral course away from the sun until it escapes the solar system beyond the orbit of Pluto which averages about 5.76 billion kilometres from the sun. It will be the first man-made object to do so.

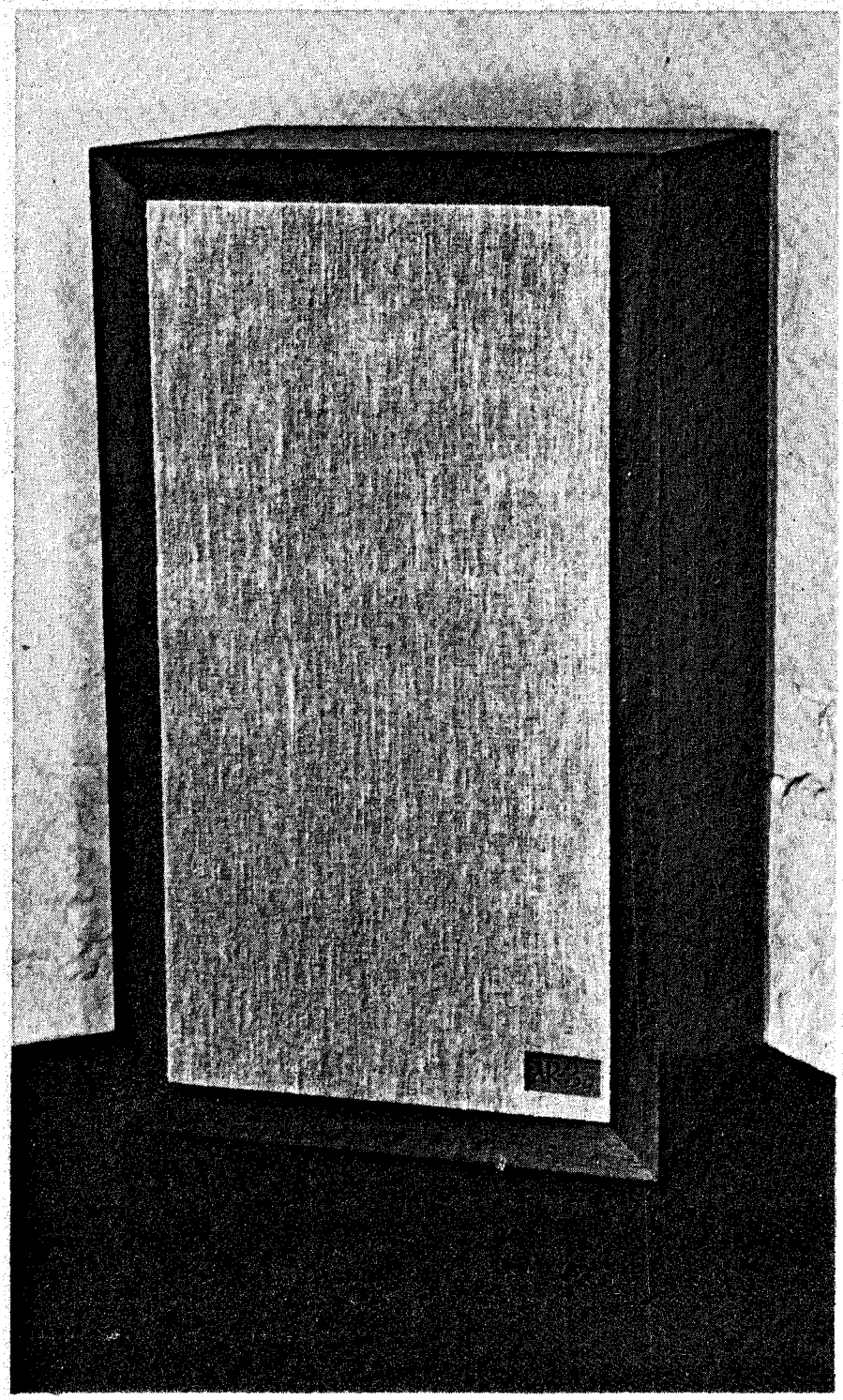
Pioneer-G's trajectory could make it the first spacecraft to fly out of the ecliptic plane (the plane of the earth's orbit around the sun). It would fly back in toward the sun, passing millions of kilometres above the North Poles of the inner planets.

It is not expected that the Pioneers could continue transmitting data to earth through all extended mission conditions. Pioneer-F's 8 W radio, for instance, will be too weak to be heard 1.6 billion kilometres beyond the orbit of Jupiter.

Pioneers-F and G are managed by the United States National Aeronautics and Space Administration (NASA) Office of Space Science and Applications with project management by the Ames Research Center, Mountain View, California. This team managed Pioneers 6 to 9, all of which are still operating in interplanetary space.

Prime contractor for the spacecraft is TRW Systems Group. – NASA. ●

CLASSICAL SIMPLICITY



THE Acoustic Research Inc. Model AR-3a speakers are the most sophisticated units that this company have ever produced. They incorporate a number of unusual design features, such as a ¾" diameter high frequency hemispherical dome tweeter, and a 1½" mid-range hemispherical dome speaker. These have a dramatic effect on the radiation pattern at the higher frequencies.

The AR-3a speakers are delivered in heavy cardboard boxes with adequate protection for all faces and edges.

Each enclosure is 14" wide by 25" high by 11-3/8" deep and is solidly constructed from heavy pineboard, finished in oiled walnut veneer. The grill cloth is a buff-coloured hessian — like material.

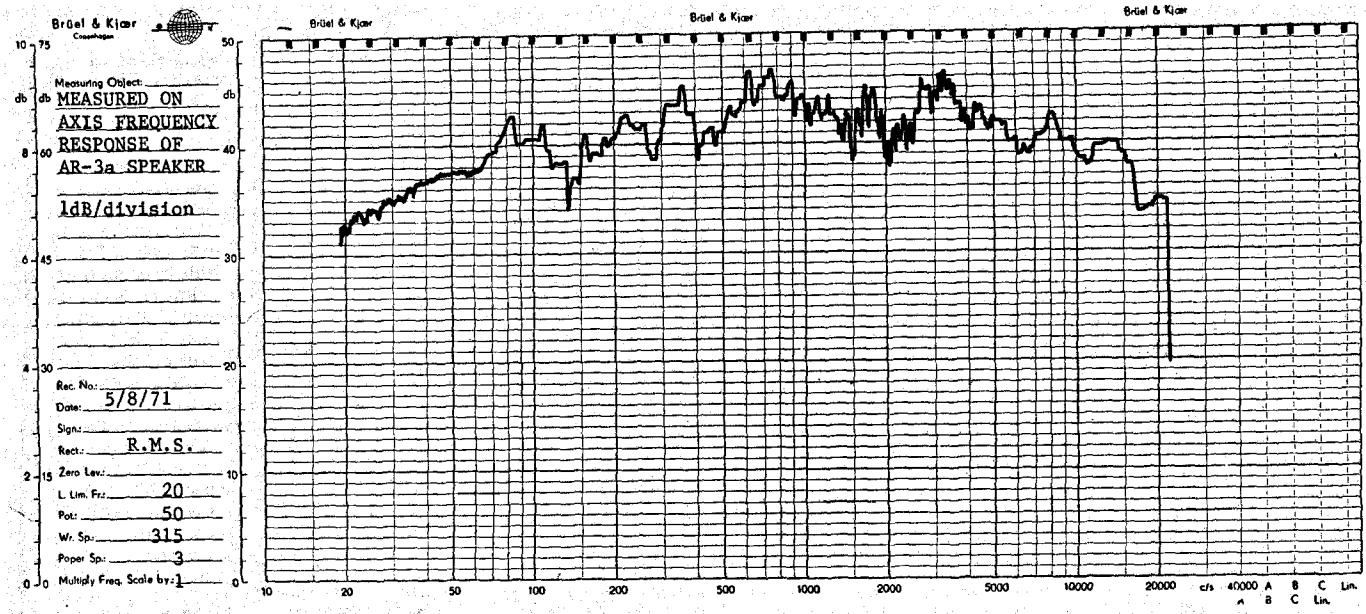
The overall appearance is unobtrusive and conservative and would readily blend in with most decors.

The speaker complement consists of a 12" acoustic suspension woofer, a 1½" midrange hemispherical dome speaker and a ¾" hemispherical dome tweeter, the total combination having a nominal impedance of 4 ohms. The crossover frequencies are 575Hz and 5000Hz. Independant level controls are fitted to the mid and high range drivers.

The low frequency crossover circuit is an LC network utilizing a massive 206 microfarad block-capacitor, one of the largest used by any speaker system manufacturer. An LC network is also used for the high frequency crossover. The 12" woofer has a rather small magnet, measuring approximately 3" diameter by 2½" deep. The small size of this magnet is particularly noticeable when compared with the midrange speaker which has a 4" diameter by 1½" deep magnet assembly.

The speaker box is internally filled with loose fibreglass wool. A paper membrane is fixed with adhesive around the back of each of the speakers to protect them against damage from the sharp and abrasive wool.

An instruction leaflet provided with each enclosure provides wiring and



We test Acoustical Research AR-3a loudspeakers

operating instructions. A guarantee card is also included. The wiring details are very brief and make no comment on the importance of correct *phasing* of the speakers for optimum stereo reproduction. The leaflet does, however, give good advice on speaker locations for optimum response.

All Acoustic Research speakers are guaranteed for a period of five years against faulty workmanship and performance in normal use. The guarantee is comprehensive, and includes not only all parts and labour costs, but also freight costs to and from the factory or nearest authorised service station. This guarantee now applies in Australia although this is not stated specifically on the guarantee. The guarantee card (which should be returned within 10 days of purchase) requires not only the name and address of the dealer from whom the speaker was purchased, but also details of the tuner, amplifier, turntable, cartridge and tape recorder used with the speakers.

One speaker had an apparent fault, this would of course be covered by the five year guarantee.

As is our normal practice, we first subjected the speaker to a listening test and then to full laboratory measurements. For the subjective tests we played some of our classical and light orchestral tapes and records

electronics TODAY product test

MEASURED PERFORMANCE OF AR-3a SPEAKER SYSTEMS

S/N 003770

Frequency Response:	25Hz to 16kHz ± 6dB	
Electro-acoustic efficiency:	1.0%	
Distortion	**Input Power**	
Frequency	10 watts	20 watts
50Hz	1½%	2½%
100Hz	¾%	1½%
Power Input	50Hz	25 watts
for 3% total	100Hz	32 watts
harmonic	1kHz	36 watts
distortion	5kHz	15 watts

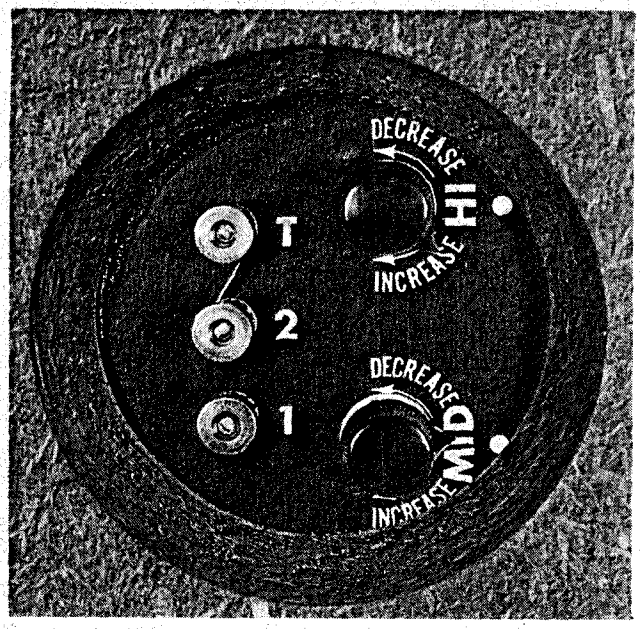
Measured range of level controls:

Frequency	Mid-Range Control	High-Range Control
600Hz	25dB	
1kHz	29dB	
4kHz	22dB	
10kHz		23dB
15kHz		22dB

Manufacturer's specification for directional characteristics: (45° of centre of the speaker)

Frequency	
400Hz	½dB below level measured on axis
1kHz	1dB below level measured on axis
3kHz	1dB below level measured on axis
10kHz	½dB below level measured on axis
15kHz	½dB below level measured on axis
20kHz	3dB below level measured on axis
Dimensions:	14" x 25" x 11-3/8"
Weight:	53 lbs
Price:	$998 per pair.

CLASSICAL SIMPLICITY



Mid and high-range level controls are accessible from the rear of the unit

through the speaker and were impressed with the exceptional clarity and absence of colouration.

The speakers are capable of faithfully reproducing every instrument.

It was immediately apparent that the efficiency was slightly lower than most other speakers that we have tested. The manufacturers acknowledge this point and recommend that the amplifier used to drive them should have at least 30 watts average output.

It is interesting to note that the manufacturers do not specify an upper power input level, particularly in view of the guarantee given. They do however recommend the fitting of fuses between speaker and amplifier to protect the speakers from excessive drive.

The measured frequency response with both level controls at maximum setting, confirmed our subjective observation that these speakers are exceptionally good. In fact they are equal to the best we have seen to date (refer to the level recording). There is a slight fall-off in the frequency response below 35Hz and above 16kHz; a point of no consequence for good hi-fidelity reproduction.

The radiation pattern of conventional type speakers is directly dependant on the input frequency and as the frequency increases, the main beam radiating from the cone usually decreases, resulting in a considerable loss of diffusion of the higher frequency components; these may not be heard unless the listener is directly in front of the speaker. The diffusion produced by the AR-3a is two to three times greater, (depending on frequency) than that obtained from most other conventional speakers. This ensures a considerably enhanced non-directional sound reproduction in any room. We were in fact surprised to find that the radiation pattern was within 6dB across a 120° arc. (As a matter of interest we have included the manufacturer's specifications for dispersion, in the tabulated results).

The mid and high range level controls had a minimum effective range of 20dB over their respective frequency bands, this is adequate adjustment for the average lounge room. Using the normal settings recommended by the manufacturer, the frequency response falls off at the higher frequencies. The manufacturers claim that this is to simulate concert hall reproduction. But in a normal living room with heavy drapes which absorb the higher frequency components it may be desirable to set the controls to provide a flatter response.

The distortion figures are indicative of the research and development work that has gone into these speakers.

It is only 3% at power levels much higher than those normally required.

The AR-3a speakers are undoubtedly the finest speakers that Acoustic Research Incorporated have yet produced.

These speakers may not suit people who like an unnatural colouration of sound, but for those who prefer clarity and faithful reproduction of every musical instrument, and who put perfection above price — they are highly recommended. ●

VERSATILE HEARING AID

ACTORS and actresses need never worry about forgetting their lines with a new medical device being developed for deaf people. It will enable them to hear the stage prompter's stage whisper — through their teeth!

And that is not the only application of the results of a new branch of medical science known as audiodontics. Dental researchers say that hearing through the teeth is almost a practical reality which may prove handy for airline pilots, car drivers, intercom and paging operators. As a hearing aid it will be virtually undetectable.

A pocket or wristwatch radio receiver and transmitter handles radio-frequency or audio signals and retransmits them to the audiodontic device in the wearer's mouth. The device may be in a dental bridge or even false teeth.

This converts the sound signal into vibrations, which are transmitted through the teeth, jaw and cranial bones to the inner ear. You can demonstrate the principle yourself by banging a table fork so that it vibrates and holding it between your teeth.

The work is being carried out by Dr. Earl Collard, of the School of Dentistry, in collaboration with Dr. Fred Allen, of the School of Engineering at the USA's University of California in Los Angeles.

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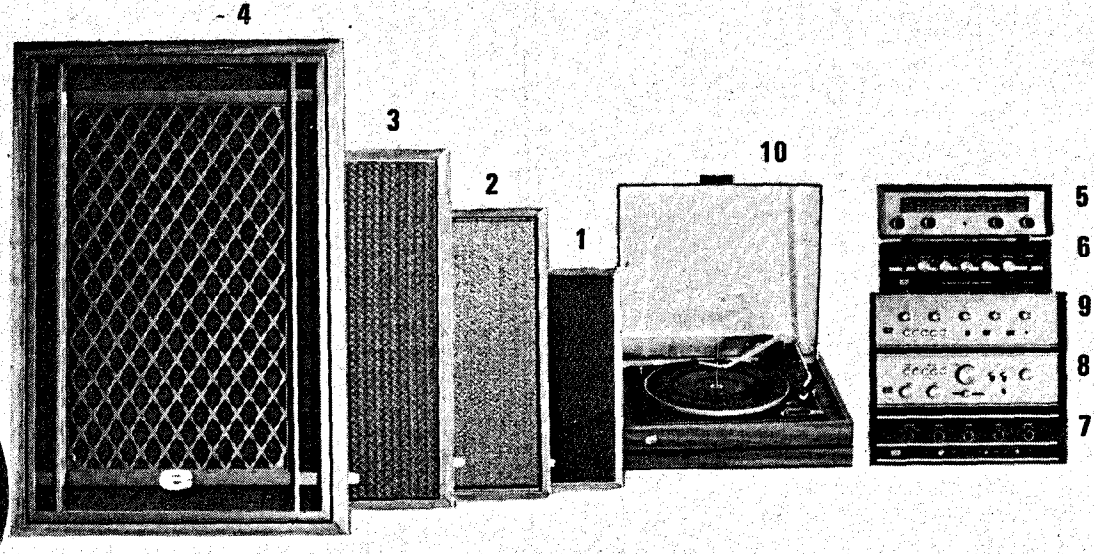

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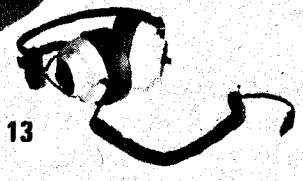
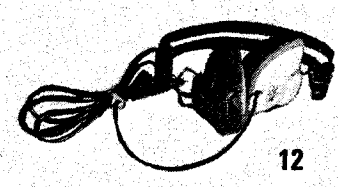


AMPLIFIERS

5. C - 100 tuner 550 - 1600 KC
6. KA - 205 6 *watts RMS each channel*
7. KA - 330 10 *watts RMS each channel*
8. TA - 3100 12 *watts RMS each channel*
9. KA - 410 25 *watts RMS each channel*



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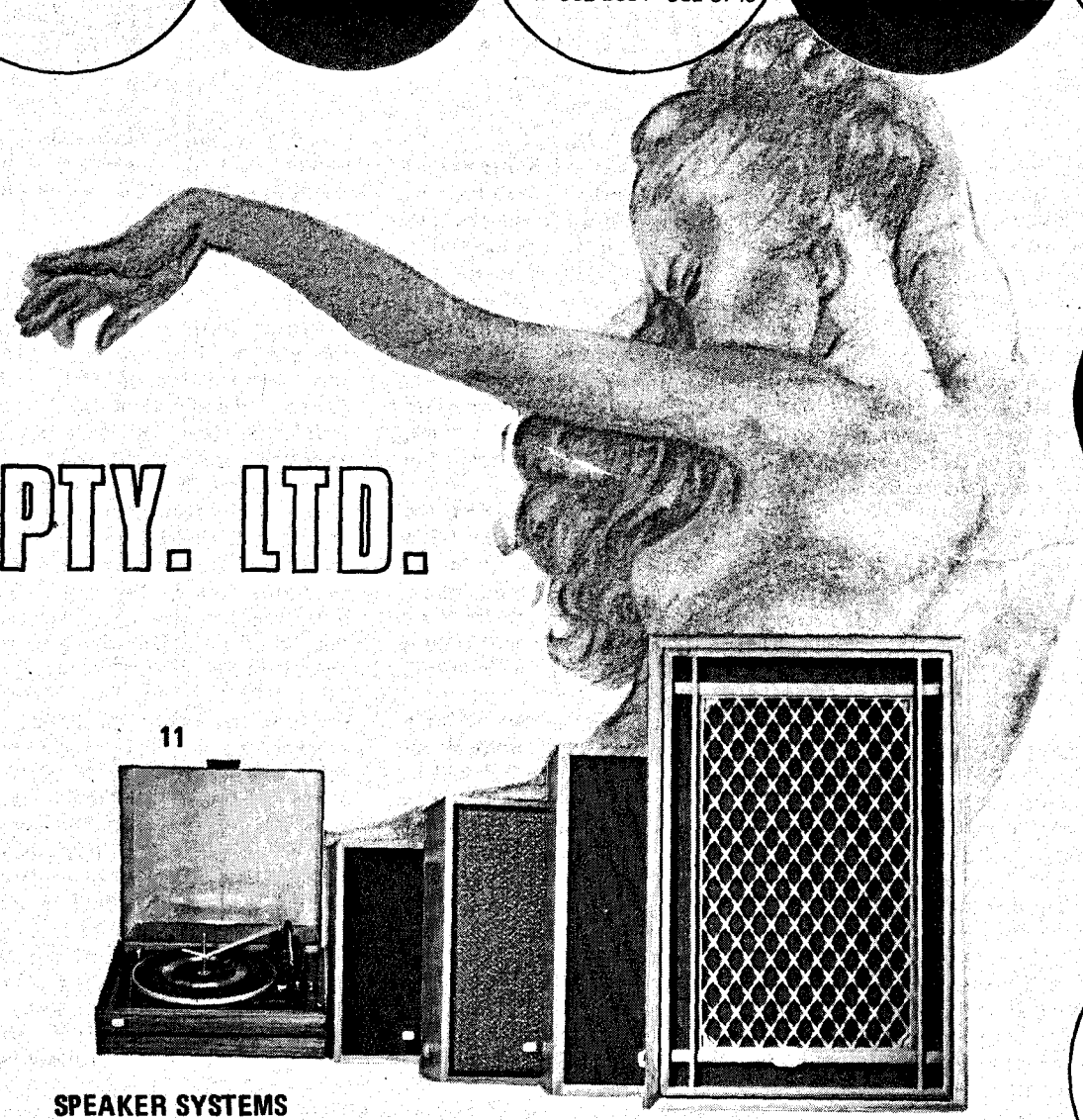

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LOUDSPEAKERS

HOW THEY WORK AND HOW TO CHOOSE THEM

As a stereo enthusiast you have a very important job to assign. Its duties go like this:

"Under direction of the amplifier, beat the air rapidly to produce sound in the vicinity. Must be able to follow complex instructions in electrical form exactly. During the forward-and-back motion in air beating, must remain as straight as possible, excessive bending or twisting will degrade results. Should suppress any preference for particular tones, accepting all tones in the widest possible range from 20 Hz to 20 kHz with the greatest possible impartiality. Ability to spread treble tones widely is highly desirable."

That's a job description for a high-grade loudspeaker, and it covers all the essential qualities. Recently, many candidates for the job have appeared, some of them boasting technical ingenuities or special design features aimed at solving one or another of the main problems of speaker performance. Some of these can confuse the buyer who finds it hard to judge how important a particular loudspeaker gimmick is to the overall quality of the sound he is going to hear.

No speaker design theory can, in itself, guarantee great sound. A high fidelity speaker system is a complicated device and every part of its design — whatever theory is behind it — must be handled carefully and skillfully if the sound it produces is to be high fidelity Let's examine, then, each of the requirements of the job description for this all-important member of the audio team. In the light of an understanding of these requirements, some of the general design methods used, not to mention specific tips on how to evaluate them, begin to make sense for the prospective buyer.

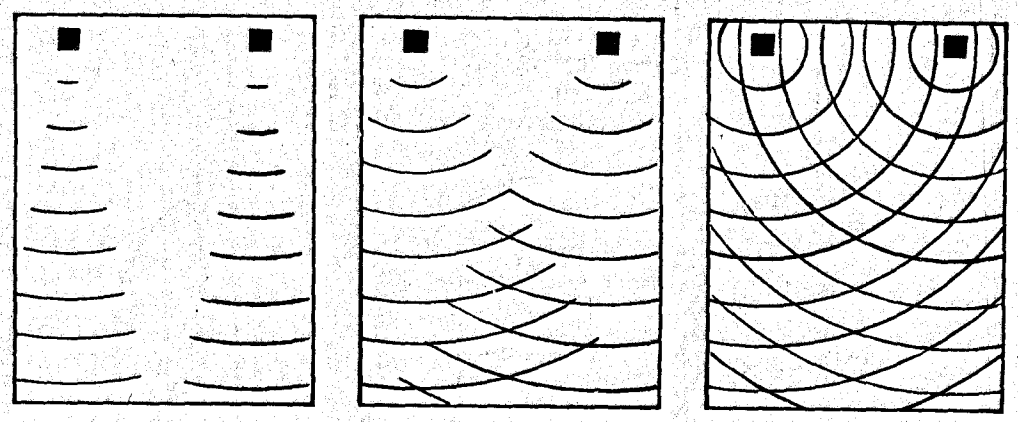
For purposes of this discussion, we may take the loudspeaker to be a dynamic model — as opposed to the relatively esoteric electrostatic, ionic, and other types that, whatever their instrinsic advantages, represent only a small fraction of the loudspeakers sold.

All dynamic speakers have a voice coil through which the audio signal passes. The magnetic field induced in the voice coil by the signal interacts with that of a permanent magnet in the speaker to produce motion of the speaker's diaphragm — usually a cone of paper, though it also may be made of plastic foam, metal, or other materials. The apex of the cone is attached to the speaker frame through a flexible suspension, sometimes made of cloth, that keeps the cone centered within the frame, but permits the piston action necessary if the diaphragm is to move air and produce sound.

Producing the Sound

"Follow complex instructions in electrical form exactly" means that the speaker diaphragm moves forward and back in precise step with the pulses of the electrical signal. Accurate frequency response, then, is the first essential for hi-fi sound in a loudspeaker. The tiniest ripple in the electrical signal must be mirrored in a precisely analogous movement of the speaker. If the voice coil or diaphragm does not follow the amplifier signal precisely, the result is distortion, or the addition of spurious tones not present in the original signal.

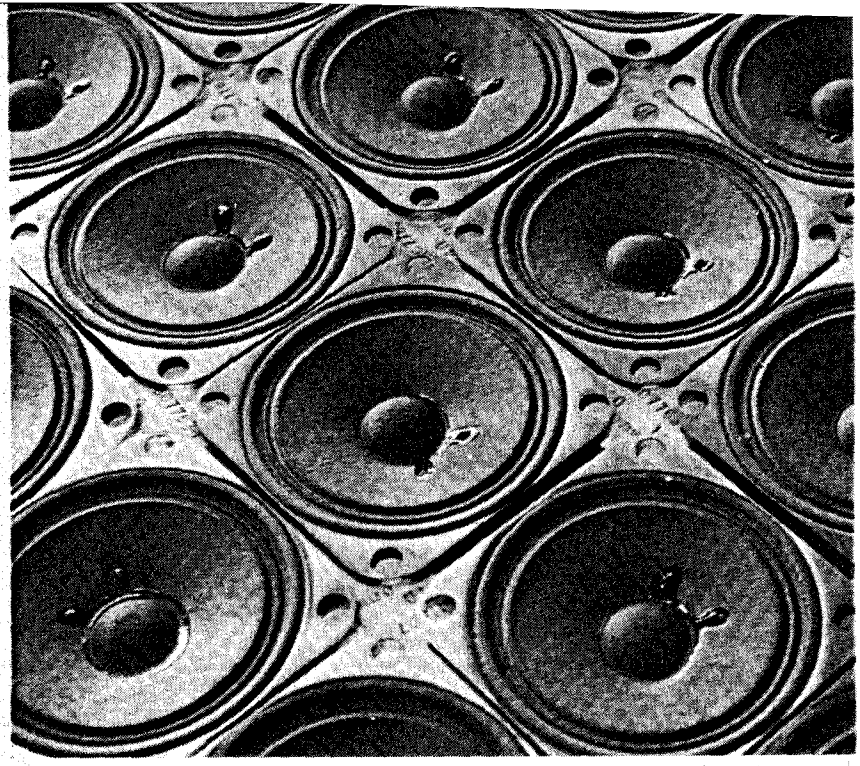
Concentrating as we are on the ordinary electro-magnetic cone speaker, we can say that if only the voice coil itself had to be considered, getting low-distortion response wouldn't be too hard. The voice coil has two main difficulties: its elastic suspension may stiffen too much when the coil moves too far (on a strong signal), thus pulling back too hard against the coil motion and cutting that motion down; and its magnetic field may vary at the extremes of the coil motion from what it is in the centre. And since coil motion depends



Sound dispersion relates to smooth response from one speaker and satisfying stereo froma pair of speakers. At left, a narrow dispersion pattern (beaming of the middle and high frequencies) lends the sound a hard or shrill quality, and fails to present a stereo panorama. Centre, wide-angle dispersion improves the response of each speaker system and enhances the stereo image in the listening room. Right, multi-directional dispersion begins to involve the room walls in a deliberate effort to increase the ratio of reflected-to-direct sound. Most of today's better speaker systems offer the characteristics diagrammed in the centre sketch; a few are claimed to offer improved stereo by utilizing "omnidirectional" spread techniques symbolized at the right.

on the signal's interaction with the field, a change in this field destroys linearity or flat response.

Speaker designers grappling with these problems have come up with effective solutions (generally speaking). Suspensions have been developed that let the voice coil move without being too stiff. The "long-throw" voice coil used in many woofers makes the total magnetic field impinging on the voice coil always the same — as turns of the coil move out of the field at one end, turns not previously engaged fully by the field move in at the other end. Another way to get the same result is to make the coil much shorter than the field. Either method can be used so that the basic drive mechanism in a cone loudspeaker has very low distortion.



Keeping It Clean

Now, let's go on to another of those job qualifications — the ability to treat all tones in the musical spectrum the same, or very nearly the same. A voice coil by itself would have one strong resonance, or highly preferred frequency. As a rule, this resonance, determined by the coil's mass and the compliance of its suspension, occurs in the mid-bass.

However, this notion is purely academic, because the speaker voice coil always has a cone connected to it; the cone furnishes the physical surface which moves the air to produce sound. And, with the cone-and-coil assembly, new problems arise.

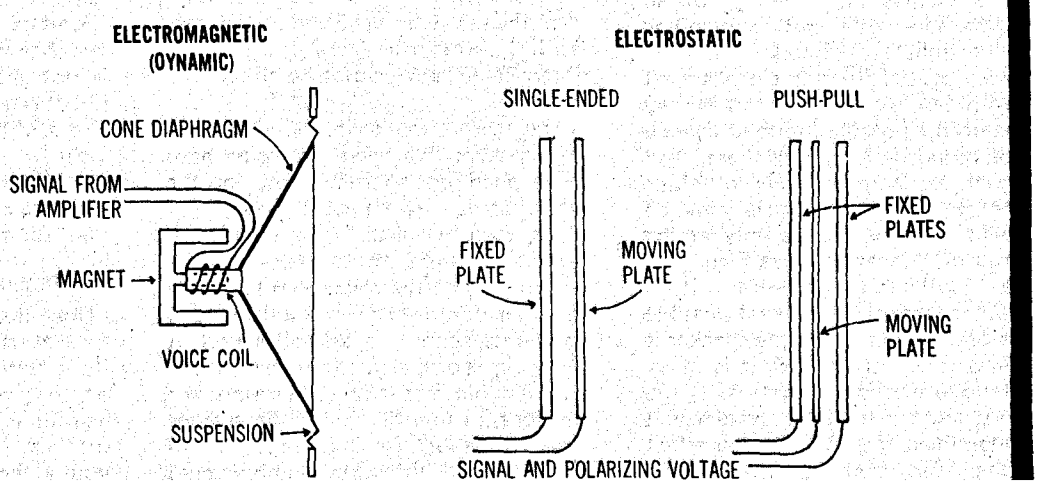
We're now dealing with a complex system that has not only a bass (or fundamental) resonance, but also the likelihood of producing many other resonances (peaks in response) up through the spectrum. These peaks occur because of minute twisting and bending of the cone (cone breakup) which creates, in effect, many different vibrating systems, each with its own basic resonance.

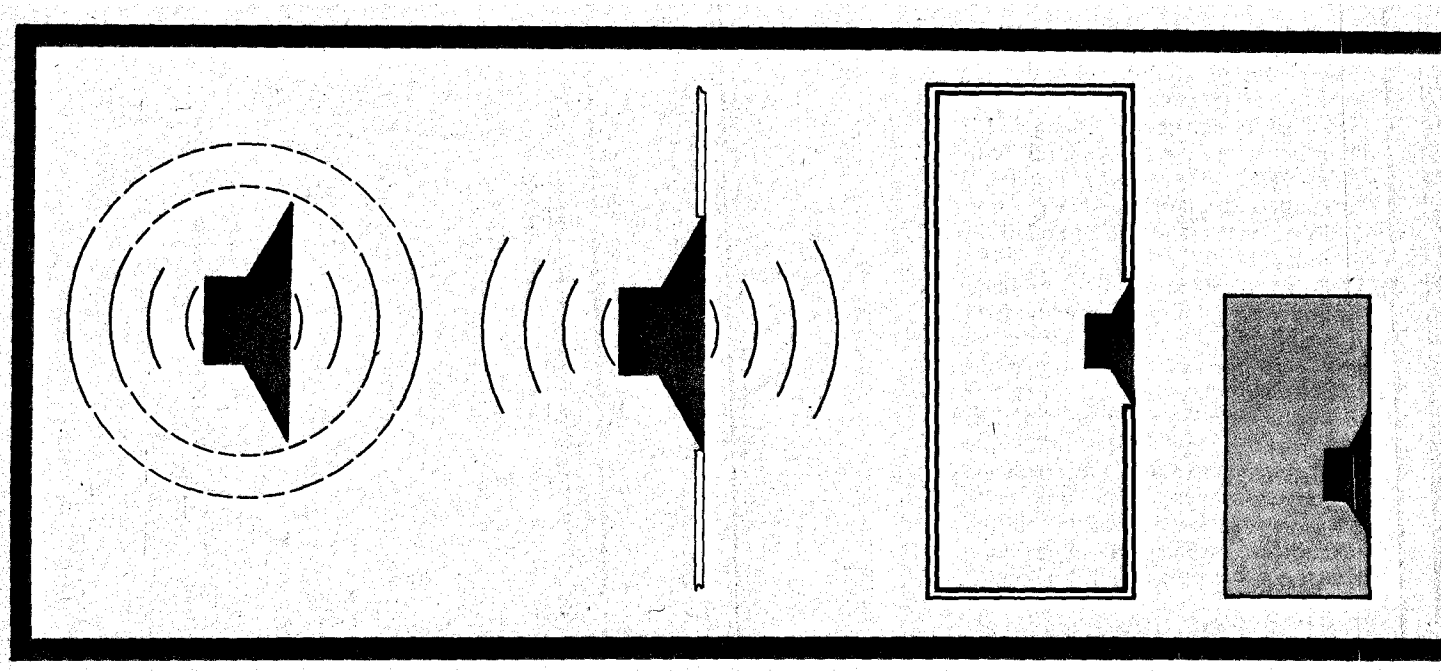
Unfortunately, strong peaks in a loudspeaker's response tend to colour the sound — to produce a tonal quality that belongs to the loudspeaker and not to the music it is reproducing. This spurious tonal colouration will depend on the particular series of peaks the loudspeaker has; the speaker tends to emphasize tones in the music that occur near its own inherent peaks.

Transients get fouled up too. These sharp impact sounds in the music tend to lose their normal "bite" and sound blurred. For instance, if the strong low-frequency resonance is not controlled in some way, the bass may sound big but also indistinct in terms of individual tones — that is, muddy. Big peaks in the midrange make for "honk", the kind of sound you get when you speak through a large tube or a barrel. Peaks in the highs may make the top treble tones sound oversharp, ringing, too bright, or harsh. A very large peak here can produce a nasty, scratchy quality that sounds very much like high intermodulation distortion.

When we talk of loudspeaker efficiency we mean simply the ratio of acoustic power delivered by the speaker to electrical power delivered to it by the amplifier. If, for example, ten watts of amplifier power will produce one watt of acoustic power (sound) output from the speaker, we may say that the speaker has an efficiency of 10 per cent — a pretty high efficiency as speakers go, by the way. If it produces only one-tenth of a watt of acoustic power, the speaker

In the magnetic speaker, amplifier signals energize a voice coil; the changes in its magnetic field cause the diaphragm to vibrate. In the electrostatic speaker, the changing field between a movable plate and one or two fixed pieces produces the motion needed for sound.





LOUDSPEAKERS

would have an efficiency of only one per cent, making it a low-to-medium efficiency design.

The complex of operative principles that go into loudspeaker design all interact, so that no one principle can be considered *in vacuo*. And since speakers are resonant devices, their action is frequency selective by definition. At the resonance frequency of a system, for example, speaker action can be very efficient – the more pronounced the resonance, the greater the efficiency, but the narrower the band of frequencies over which that efficiency will hold up. Since a good speaker system is expected to cover some nine octaves, however, a narrow band of optimum operation is not sufficient even when the total range is divided into three or four bands, each handled by an individual driver.

Damping is a common method of smoothing out response peaks. There are many sorts of damping but all work to the same end: controlling disproportionate effects in the speaker's action. Resonant peaks must be controlled, for example, but as they are reduced to usable limits efficiency will be reduced along with them. And inasmuch as damping tends to reduce efficiency, smooth response may be achieved in some designs only at the expense of efficiency. (See Figure 1.)

The speaker enclosure itself introduces one of the several possible forms of damping. When the speaker is put into a sealed box, as it is in an acoustic-suspension system, the primary resonance of the system will be determined by the damping effect of the air trapped within the enclosure. It is this fact that has led to use of the term air-suspension to describe the smaller systems (typically: the two-cubic-foot size) that rely on the damping effect of the enclosed air to control cone action and therefore the resonant peak. In such a system the volume, and hence stiffness, of the air is critical for proper action and is carefully matched to the other parameters that affect performance.

If you look at Figure 2, you will see how response is affected by various amounts of damping – expressed as a value of Q, though high Q means little damping and low Q heavy damping. Note the linear portion at the right end of the curve. This is the lower end of the so-called piston band, where diaphragm action is relatively linear. As damping is increased toward a Q-value of 1 (and efficiency at the resonant frequency is consequently decreased), the flat portion of the curve is extended progressively toward the left. But no matter what the Q-value, the bass falls off relatively steeply below the effective resonant frequency. These curves, therefore, demonstrate why efficiency, response, and damping are intimately interrelated and cannot be considered alone.

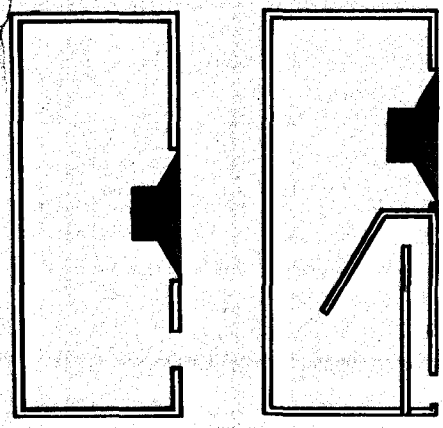
The factors in the initial winnowing of speakers I've been discussing have now piled up so high that, for the uninitiated, they are liable to topple of their own weight. So a couple of examples ought to be helpful. First you must classify your room to decide whether you need a very loud sound, a moderate sound, or a small sound. A very big room, say, more than about 4,000 cubic feet takes loud sound; but so does a room of smaller dimensions but with a lot of sound absorption in the form of thick rugs, upholstered furniture, heavy hangings. Obviously, then, the combination of big room and lots of absorption needs the most sound. A moderate-sized room – say about 3,000 cubic feet – with lots of absorption takes a loud sound; the same room with little absorption takes a small sound. In a really small room with 2,000 cubic feet or less and mostly hard surfaces, a very small sound will be as loud as you can stand.

Let's say you have a room near the 3,000 cubic feet median, with average absorption. Then, speaking very roughly, the combination of a 10-watt amplifier with a high-efficiency speaker would probably give you maximum loudness far above your desires; you can run your system satisfactorily without turning up the volume very far. However, the joker in that formula is the relative scarcity of truly high-grade amplifiers rated as low as 10 watts: you probably would choose one of the good 15-to-20 watt amplifiers, and have some amplifier power reserve – not a bad idea at that, if you can afford it.

With a low-efficiency speaker in the same room, you would probably want 25 watts or more of amplifier power per channel. This discussion, of course, is not about the choice of amplifiers but about the choice of speakers: what I've said here will allow you to adjust your speaker-and-amplifier combination, after you've zeroed in on a speaker or two, to full loudness in your room.

The Importance of Listening

How do you tell whether or not a speaker is high or low in efficiency? Your audio dealer can be very helpful on that point. He can be even more helpful – and this is the real crux of speaker selection – if he will allow you a few days in which to test at



Rear sound waves from unmounted speaker cancel front waves, weakening bass output, Simple baffle helps bass response but must be enormous (in theory, infinite) for optimum job. Enclosed box can approach "infinite baffle" performance, but for good results box must be fairly large and speaker must have low resonance and good cone-restoring force built into it. Air suspension system swaps large enclosure volume for trapped air in smaller enclosure which aids response of low-resonance, loosely suspended ("long-throw") woofer. In bass-reflex enclosure (sized somewhere between infinite baffle and air suspension) rear wave is inverted in phase, emerges from auxiliary opening known as a port to reinforce front wave. Horn-loading, on front or rear of speaker, is another way of efficiently coupling bass from speaker diaphragm to listening area.

home the two or, at most, three speakers that seem to fit your needs best. Discussions of design theory and published speaker tests notwithstanding, *the only way to know how a speaker will sound in your room is to listen to it in your room.* The difference between what it does there and what it does in another room, including the audio shop's listening room or a testing lab, can be drastic.

At home, you can quickly get a line, first, on how the power-efficiency combination works for you. Put on some recordings with massive fortissimos. You must be sure that the recordings themselves provide those fortissimos without distortion, and that your pickup (or tape machine) can handle them effortlessly and cleanly. If there seems to be some evidence of overload trouble on the very loud bursts when they are turned up much louder than you would normally want to hear – a blurring or "falling apart" of the orchestral texture, or a loss of definition – then your amplifier is probably running out of power at those crucial points. You can move in either of two directions: a bigger amplifier, or a more efficient speaker. (It's much less likely – but possible – that the speaker is overloading on the loud bursts.)

Designing For Hi-Fi Response

Among the main varieties of available speakers some standard and some fairly far-out methods are employed to solve the problems of good response; fairly popular is the two-way or three-way speaker system in a sealed box, using cone speakers for all ranges. The woofer is usually a long-throw speaker whose ability to move very far makes it capable of putting out a lot of bass. The suspension of the cone is very compliant to permit large cone excursion without tightening down. A good part of the "restoring force," the springiness that keeps the cone coming back to its centre position, comes from the air trapped in the tightly sealed box. Since the air pushes back much more evenly than a mechanical spring suspension would, distortion that might otherwise be caused by stiffening is significantly reduced. That, in a nutshell, describes the widely used "air-suspension" system that has brought good bass performance to many comparatively small speakers.

There are other ways of handling the enclosure-and-bass problem. One of the oldest is the "bass reflex," an enclosure with a carefully proportioned hole, or port, out of which the rear wave of the woofer can emerge in phase with the front wave to reinforce the bass and smooth its peaking tendency.

Many speaker systems show signs of using variations of these basic design approaches, or of borrowing certain aspects of more than one "pure" design approach. One general class – using a ported enclosure – also makes use of physical damping material, such as glass fibre, which serves as an acoustic resistance to help smooth the response of cone speakers. This acoustic resistance can "tame" midrange peaks that result from reflections inside the enclosure. It also can reduce a speaker's tendency to "ring," or keep on sounding at the bass resonance, a main cause of muddy bass.

Very heavy damping has a very strong smoothing effect (a box packed tight with glass fibre would constitute heavy damping). But this in turn introduces some problems, mainly a fall-off in general response in the bass. About the only thing we don't have to worry about in bass reproduction is the sound dispersion pattern; bass notes just naturally spread out evenly in all directions.

What are the devices used for good treble sound? The small, light-coned tweeter has a predisposition for the treble. If made in a dome shape (convex side toward the listener), it can be resistant to breakup in the high frequencies. The dome has another advantage in that it spreads the treble out more than would a simple cone shape.

There are other ways to get good treble dispersion. An acoustical lens fitted over a tweeter helps spread the sound. Some systems employ several tweeters, mounted in an arc so that they will radiate over a wide angle. Another technique is to use a small horn with a wide horizontal projection pattern; the sectoral horn does well in this respect. Still another technique is to mount the tweeter so that it projects its sound upward; if the sound then is bounced off a vertically mounted, plug-shaped reflector, it can radiate over a full 360 degrees. Or the tweeters can be pointed toward the wall at sides and back so that the treble is bounced out over a wide angle. Mounting several tweeters in a vertical column has the effect of spreading the highs in the plane at right angles to the long axis.

A speaker-system designer faces a mind-boggling basketful of difficult, and sometimes mutually incompatible, decisions – the nature of which has been suggested by the design theory rundown just concluded.

Choosing a Speaker System

That realisation should be in the back of your mind when you go out to audition candidates for your loudspeaker job. First, decide how much money you can spend, how much power-handling capacity you need (see article How Many Watts – 'choosing amplifiers and speakers to match your room size' – Electronics Today, May 1971), what will fit into the space and the decoration scheme you have. Without some such categorization, you'll lose your way among the hundreds of speakers in the audio shops.

As to money, it's a good idea to maintain a rough balance with the cost of the other components in your audio system. A reasonable rule of thumb, bendable this way or that as need be, is to spend about as much in total for the two stereo speaker systems as for the electronics (amplifier or receiver) that will drive them.

In most cases, this will also get you within the power-handling limits. These are not too restrictive, in any

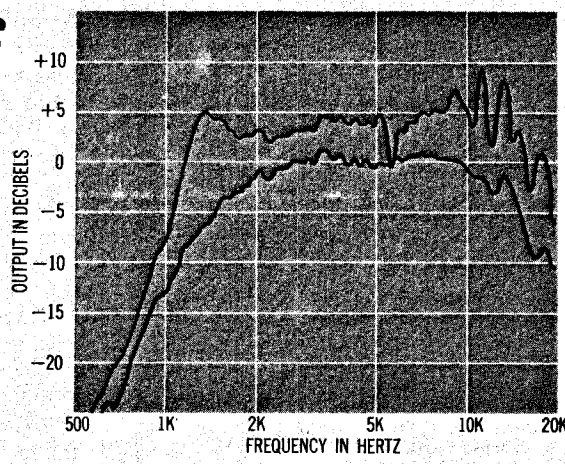


Fig. 1. Two response curves for same speaker show undamped (top curve) and damped response (lower).

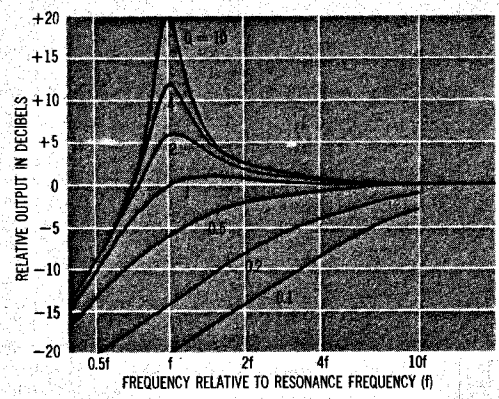


Fig. 2. Response curves show how low-frequency response is affected by various amounts of damping.

Fig. 3. Estimated speaker output power required for different desired sound levels in average room.

case. The main error to avoid is the use of a very small, low-powered speaker with an extremely high-powered amplifier. There are a number of amplifiers on the market today with massive power, enough to damage a lightly-built speaker, if the volume is turned very high. A fortissimo burst of sound may rupture the speaker; a steady high volume — as from loud, sustained organ music — might burn out a voice coil. But an amplifier capable of damaging a medium-capacity speaker in this way is likely to be expensive as compared to the speaker, so the balanced-budget approach gives considerable protection. Beyond that, you can compare the maximum power rating of the speaker, in watts, with the maximum output power of the amplifier. A speaker rated to handle no more than 20 watts, say, should not be connected to an amplifier rated at 40 watts or more.

The reverse mismatch, with a speaker of high maximum power capacity and a low-powered amplifier, carries no hazard to damage, except, possibly, to your bank balance, since the speaker is likely to be in a considerably higher cost bracket than the amplifier.

It's very important to note that the maximum power capacity of a speaker does not translate directly into how much soundpower the speaker will put out; maximum power capacity is simply the upper limit of the electrical power the speaker can handle without danger of damage.

The amount of sound or loudness a speaker puts out depends on another essential factor, namely speaker efficiency, as applied to the amplifier's maximum output. As an example, 5 watts fed to a highly efficient speaker might sound louder than 50 watts fed to a very low-efficiency speaker.

A further essential qualification: efficiency is not directly related to *quality*, to good handling of the various parts of the loudspeaker job we've discussed. Some of the very best speakers now on the market have low efficiency. In practical terms, all this means is that the user must have more amplifier power than he would need with a high-efficiency speaker.

Happily, the speakers made by reputable hi-fi component manufacturers, those you are likely to audition for the job in your living room, will have, as a class, at least moderately good control of peaks. You will never encounter among *them* the kind of scratchy blur-out mentioned in the last paragraph. (Try a pocket-size transistor radio for that effect.) You are concerned with distinguishing between the good and the excellent in selecting the candidate best suited to your room and the amplifier used in your system.

In addition to peaks and valleys that occupy narrow ranges of the musical spectrum, a cone loudspeaker tends to fall off steadily in the bass, below its fundamental resonance, and also in the extreme highs. Extending the bass has traditionally meant using a fairly heavy cone, which must be either very large in area, or at least moderate in area and capable of very long motion, or back-and-forth excursion. Extending the treble, conversely, has meant using a very small, light cone. The incompatibility of these two requirements has led to the near-universal practice in high-quality speaker systems of using at least two speakers (or "drivers") to cover the range: the large woofer for bass and the small tweeter for treble. Many speaker systems go a step further: a three-way division, with a midrange speaker.

Dividing the range gives the speaker designer the opportunity to make each individual driver do a much better, smoother job: that opportunity may be used with varying degrees of success, emphasizing again my point that no one design approach or scheme guarantees great performance. Dividing the range, in fact, adds a number of complications to an already complicated device. The crossover or dividing network that feeds the correct tones to each speaker in a multidriver system can itself introduce distortion if it is not well made.

But properly done, the two-way or three-way speaker system — all other things being equal — can produce smoother bass and treble than can a single speaker. For this reason, most of the top-grade systems divide the spectrum or at least employ more than one driver.

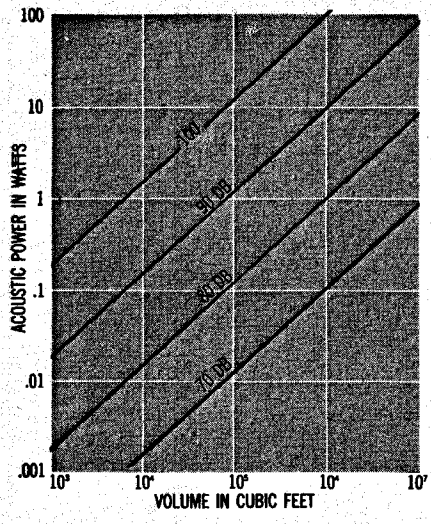
In a divided-spectrum system, of course, the two or three ranges covered must be well balanced with respect to each other. For instance, if the bass is relatively weak (with respect to bass and highs), the system will sound somehow unreal or remote — perhaps veiled. Weak highs, of course, make for dull sound, lacking in definition and normal bite.

Conversely, too much bass means overheavy or tubby sound: too much midrange, a kind of thrusting "presence", as if everything were out in front, pushing at the listener: too much treble results in oversharpness, an aural effect somewhat akin to the visual effect you get from a television image when the contrast is turned too high. This "over-etched" quality is preferred by many listeners, but it is really a subtle form of distortion.

Spreading the Sound

The speaker's ability to spread the treble in the room is another important "job requirement." A large shallow cone or diaphragm will beam the highs, concentrating them into a more or less narrow area on the axis of the speaker.

This means, for one thing, that the speaker will sound too sharp and



"hard" when you listen from directly in front of it, too dull if you sit more to the side. The stereo image will be degraded because stereo depends to a large extent on a speaker's ability to handle the mid-range and highs evenly and smoothly. You may get good stereo if you're listening from a spot that is intersected by the beams of the left and right channel speakers, but things change for the worse in all other positions in the room. Moreover, even at that one critical spot, the sound produced by beaming speakers will probably become fatiguing after a while because it will be distorted sound.

These general considerations, then, underscore your requirements for linearity, low distortion, smoothness of response, extended range, tonal balance, and wide dispersion of treble. In addition, we've been hearing lately of yet another aspect of speaker performance, one that carries us perhaps beyond the area of generally accepted criteria into an area in which personal taste becomes more important: the balance between reflected and direct sound.

Every sound heard in an enclosed space – such as a normal room – is a combination of direct sound, travelling straight from its source to the ear, and reflected sound that has bounced one or more times from the inner surfaces (walls and physical objects) of the room. In a concert hall the ratio of reflected to direct sound establishes the acoustic character or ambience of the listening experience: this can vary from big, full, spacious, and warm to tight, close-up, thin, dry, or cool.

Every recording contains some measure of reflected sound, depending on the recording director's choice of a hall or studio and his use of microphones, their placement, and several other factors. Presumably, the acoustic character of a recording is intended to suit the music and its performers so that the end result will prove attractive to the listener.

The room in which you listen to the recording, however, also influences this acoustic character, because in it you get an additional mix – during playback of the recording – between direct and reflected sound. To be sure, a normal home listening room is much smaller than a concert hall, and thus – for symphonic or other large-scale orchestral works – it has less influence (less time lapse between direct and reflected sound) on the over-all character of the sound.

But it has *some* influence, which seems to rise in inverse proportion to the size of the ensemble on the recording. In any event, the simplest way to alter the ratio of reflected to direct sound on playback would be to aim the speaker toward a wall rather than directly at the listener. The resultant reflection added by the room may round out the sound just enough to add a sense of spaciousness or broader ambience to many recordings.

If you like the speaker very much on other counts, obviously it's the amplifier that has to make the adjustment.

Those "other counts" are the ones I've been discussing through most of this article. And so, here are some suggestions on how to judge the speaker's handling of each of the job requirements as set down earlier. Using several recordings you know almost by heart is essential. They should contain plenty of full-orchestra fortissimos.

For linearity: once you are sure neither your pickup nor your amplifier is overloading in heavy passages, listen very carefully to what happens to tonal definition in such passages. As indicated, almost any speaker in the audio shops today, except perhaps those with extremely low price tags, will not overload in a grossly distorted manner; you are listening for subtle rather than gross differences.

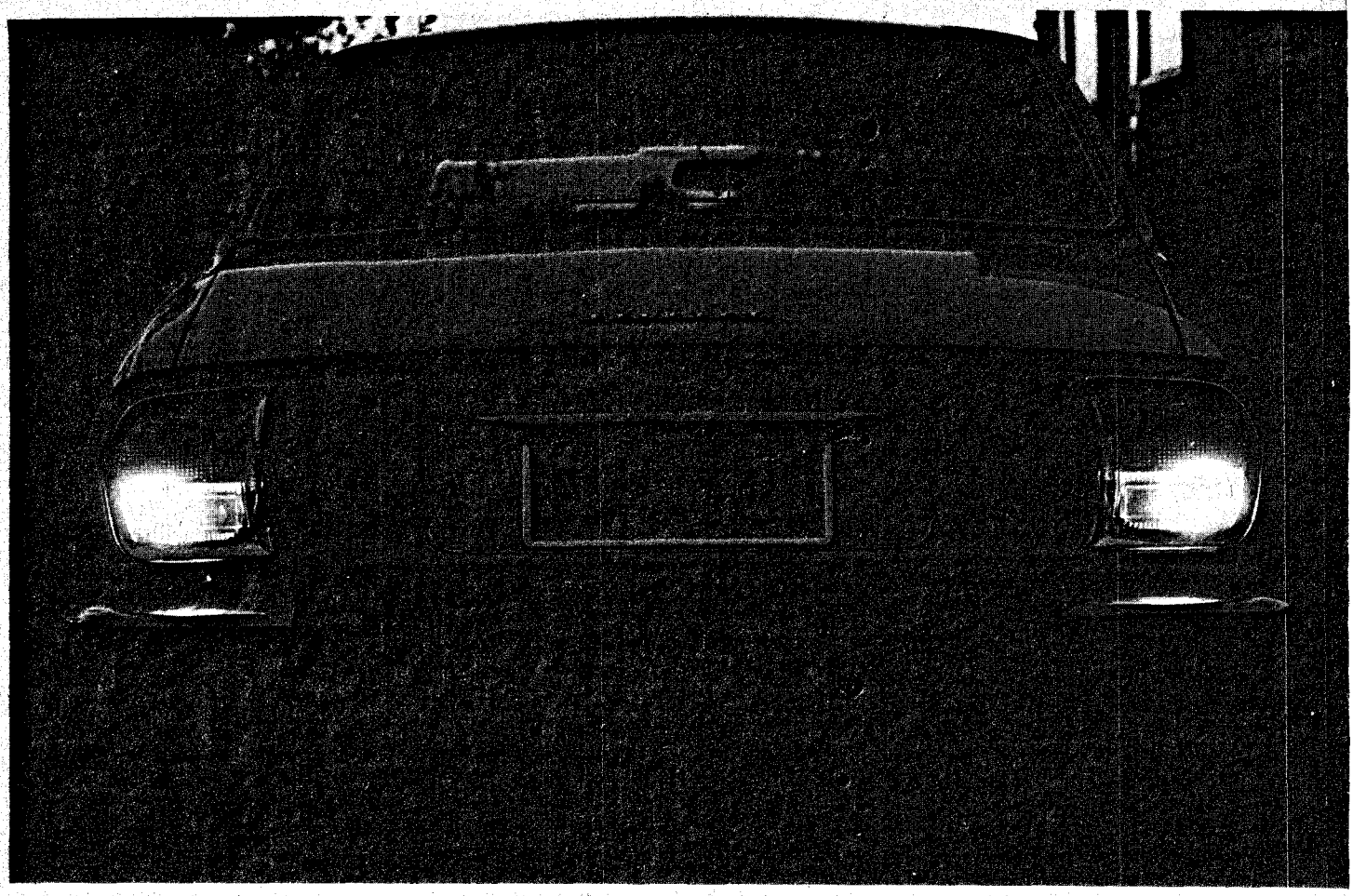
For smoothness: today's speakers vary more in this characteristic than in any other. And here, direct comparisons between two speakers would be most valuable because the differences, again, are likely to be fairly subtle. Once you hear uncoloured reproduction of a certain passage, peaky colouration becomes much more evident. This is a kind of distortion you can easily overlook at first if it's not too strong; but long hearing can make it more and more obtrusive, giving rise to that often unconscious disinclination to listen to your system, the result of "listener fatigue." Take note of any thuddiness or boominess or blobbiness in the bass, honkiness in the middles, harshness or scratchiness in the highs. For the last quality, massed treble voices are an excellent test. Loud choral music, in fact, is especially difficult to reproduce well and will often help you distinguish between two speakers that otherwise seem about on a par.

For lower bass: the organ pedal notes, as might be expected, are the best test for lowest bass. An organ pedal passage that moves up and down the scale will tell you whether or not your speaker is able to handle the whole bass range, or just a couple of notes – or one (which can give a false impression of great bass response) – in the low bass.

For highest treble: listen most carefully to strong cymbal passages. Are they ultraclear, airy, with an open, natural "ringing" quality (not the overemphasized "ring" of bad peaks, but the clean, metallic sound that cymbals actually make)? The cymbals will sound somewhat *enclosed* if treble is cut off too short, or if it is weak. They will sound scratchy or papery if there are strong peaks in the treble. This is such a revealing test that it is worth listening in advance to some "live" cymbals, if you can arrange that, to try to fix in your mind what these instruments really sound like.

For wide dispersion of treble: walk across the room, passing the front axis of the speaker. Notice if the sound is markedly brighter on axis, duller at the sides: that means excessive beaming. Some beaming is to be expected in most conventional systems, though it should be fairly minor. By "conventional" I mean all loudspeakers except the omnidirectional models, of which so many designs have been put on the market recently. An omnidirectional speaker is one that uses some method of spreading out all the sound – even in the high treble range – in a 360-degree "spray" around the enclosure. Some models have built-in reflectors to accomplish the purpose: others have several drivers angled in different directions. Many of these models may not be intended for use against a wall like conventional speakers, though some in-between designs aim to spread the sound over only 180 degrees or so through the use of special reflector techniques.

Finally, listen attentively to your trial speakers for a few days. In the present state of the art, there are differences between speakers that can't be put down to good and bad – they are too subtle for that. But it's practically certain you will have a personal reaction to these differences if you listen carefully for some time. Don't make a quick judgment on such imponderables, but once you are sure of it, go with it. ●



BRAKE LIGHT WARNING

ET PROJECT 303

Faulty brake warning lights are dangerous — to others as well as to yourself. This simple fail-safe unit tells whether they are working, at all times.

A vehicle with inoperative brake lights is a menace on today's roads.

But what is far worse is a vehicle with only one brake light working, for this may be mistaken for a turning indicator.

Electronics Today's brake alarm unit detects both conditions. It indicates, via a dashboard mounted lamp, that both brake lights are working each time the brake pedal is depressed. If either or both brake lights fail, then the indicator lamp fails to light.

As the great majority of cars use 12 volt electrical systems, the unit has been designed specifically for this system. It will not work satisfactorily with six volt systems.

The unit shown in this article is for vehicles with negative earth systems. The unit can be constructed for positive earth systems merely by substituting transistors shown under 'positive earth' in the parts list. Make sure that you specify the correct type for your vehicle when ordering the components (or kit set) from your parts supplier.

The unit is shown here in two forms, in its simpler form (Fig. 1) the indicator light operates at the same

intensity day or night. A simple modification to the basic unit, (Fig. 2) automatically reduces the intensity of the indicator light when the headlights are switched on.

Many vehicles are fitted with a handbrake warning light, and this can be adapted as a dual purpose indicator. Alternatively a separate indicator light may be used.

CONSTRUCTION

Our original prototype was constructed on a printed circuit board the foil pattern of which is reproduced (full size) in Fig. 3. Alternatively, the components may be assembled on veroboard, matrix board, or tag strips. The layout is not at all critical.

The component layout for printed circuit board construction is shown in Fig. 4. The same board and basic component layout is used for both versions of the unit. In the simpler version the extra components are omitted and resistor R8 replaced by a shorting link. At this stage do not install R3 (220 ohms).

The completed board should be mounted in a small case – we used an aluminium case 3" x 2" x 1½". Ensure that no internal wiring touches either R1 or R2, as these become hot when the brakes are used for a long period.

INSTALLATION

Locate the box in a convenient place under the dashboard or in the engine compartment.

Now refer to Fig. 5.

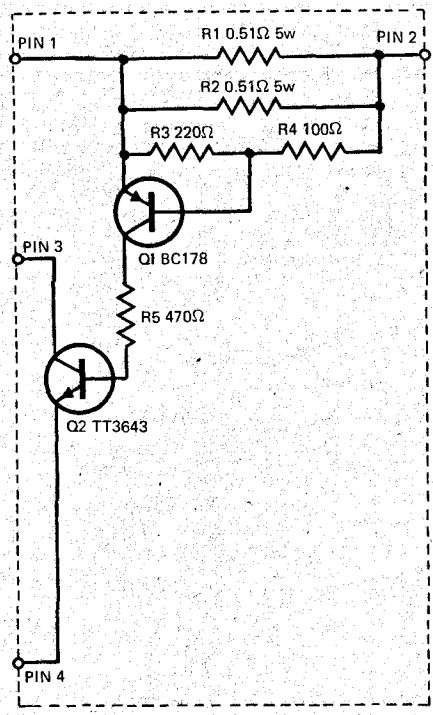


Fig. 1. Circuit diagram of the basic unit.

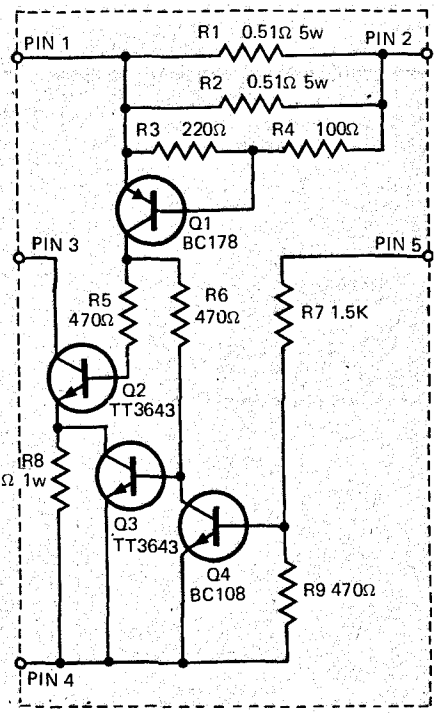


Fig. 2. In this form the intensity of the indicator light is automatically reduced when the headlights are switched on.

The existing wire from the brake lights is removed from the brake switch and wired to Pin 2 of the warning unit. A new wire is then taken from the brake switch to Pin 1 of the warning unit. Pin 4 is connected to any convenient earth. In the automatically dimmed version of the unit, Pin 5 is wired to the switched side of the side or tail-light circuit.

The brake warning indicator light should be rated at 12 volt, approximately 150 mA. One side of the light should be connected to the vehicle's 12 volt supply, preferably via the ignition switch, and the other side of the light is wired to Pin 3 of the warning unit.

If a handbrake warning light is fitted to the vehicle (and if the actuating switch is of the type that earths one side of the light when operated) then this handbrake light may also be used for the brake warning function. All

Fig. 3. Foil pattern for the printed circuit board (full size).

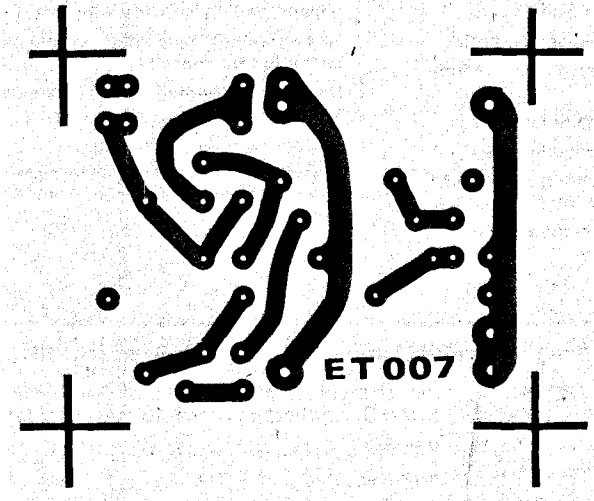
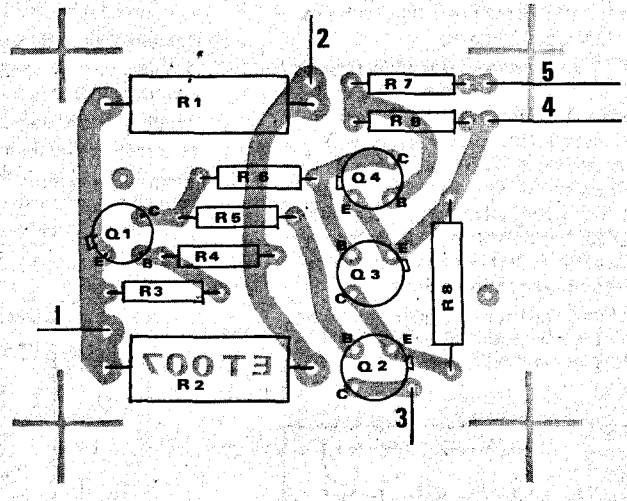
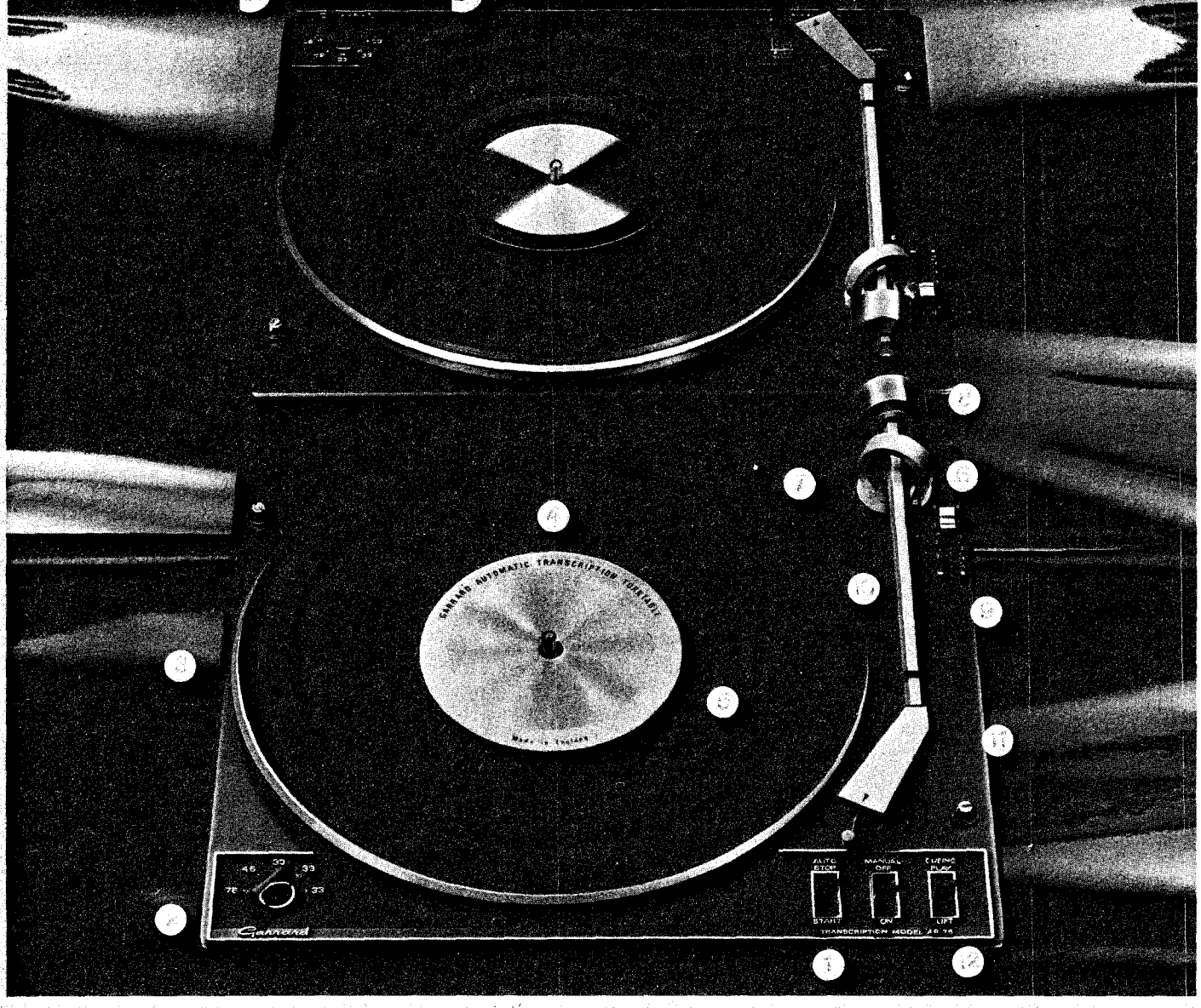


Fig. 4. How the components are assembled on the printed circuit board – in the basic version some components are omitted, and a shorting link wired across the position shown for R8.



before you buy a turntable reflect



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- Gimballed, needle-pivoted pickup arm mount.
- Precision, resiliently mounted counter balance weight with fine adjustment.
- Sliding weight pickup bias compensator, calibrated for spherical and elliptical styli.
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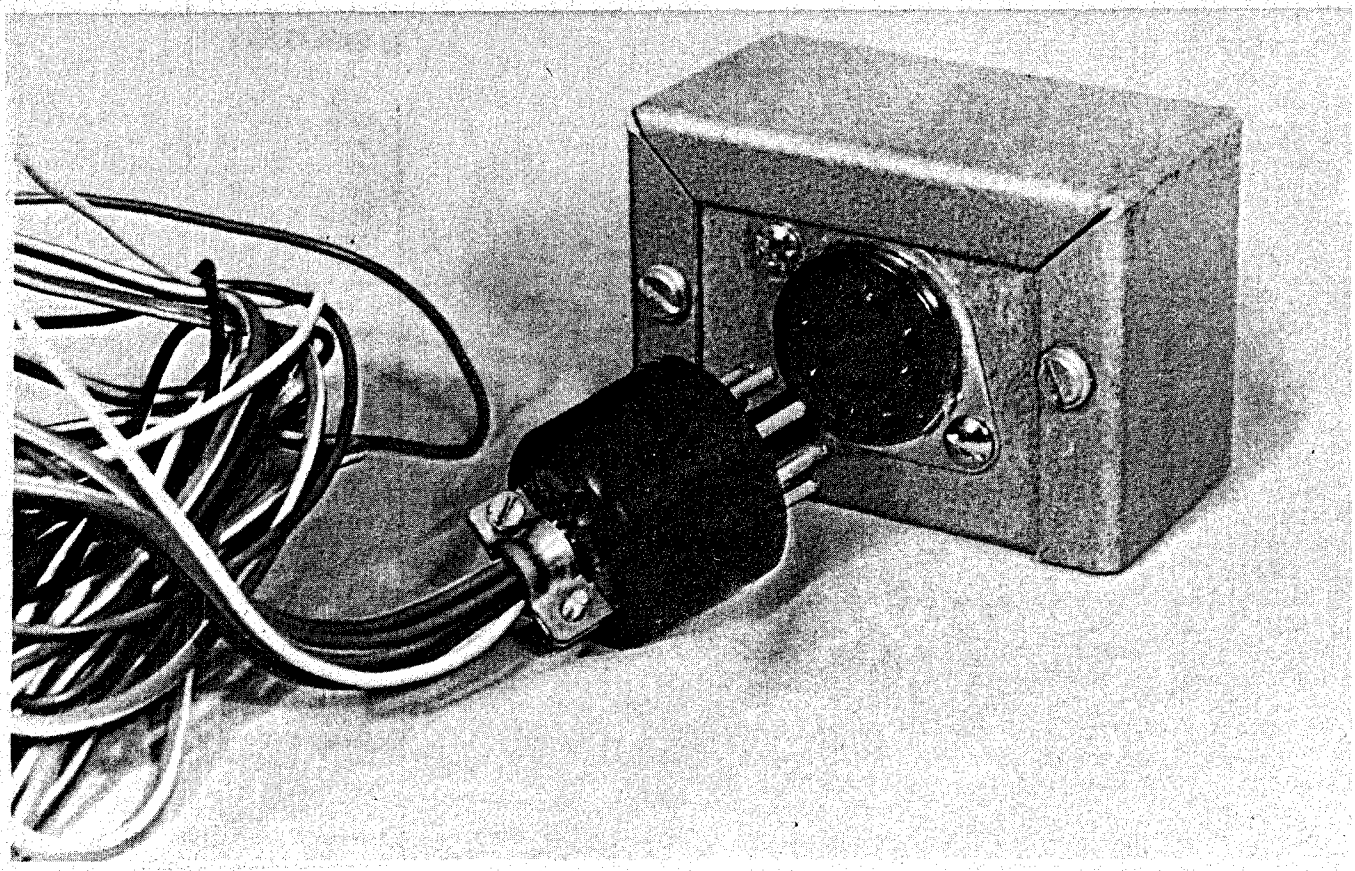
BRAKE LIGHT WARNING



The completed unit — we used an octal plug and socket to connect the unit to our testing vehicle, but for general use it is better to connect the unit directly to the vehicle's wiring system.

that is required is to connect Pin 3 to the junction of the handbrake warning light and the actuating switch. (Fig. 5 refers).

TESTING

Having installed the brake warning unit, chock the wheels of the vehicle, release the handbrake, switch on the ignition and depress the brake pedal. The brake indicator light should be illuminated each time the brake pedal is depressed.

Now remove one of the rear light bulbs and depress the brake pedal again. This time the light should not come on. Check that it does not come on when the engine is running (i.e. when the battery voltage is higher). Replace the rear light bulb.

Finally — if the modified circuit is used — switch on the sidelights, and again press the brake pedal. This time the light should be illuminated, but with decreased brilliance. The degree of light reduction is determined by the value of R8 — this is normally 33 ohms but may be varied as required.

FAULT FINDING

Indicator does not come on at all.

If the indicator does not light up

PARTS LIST

Negative earth vehicles.

Q1	—	transistor	BC 178
Q2	—	"	TT 3643
Q3	—	"	" "
Q4	—	"	BC 108

Positive earth vehicles

Q1	—	transistor	BC 108
Q2	—	"	TT 3638
Q3	—	"	TT 3638
Q4	—	"	BC 178

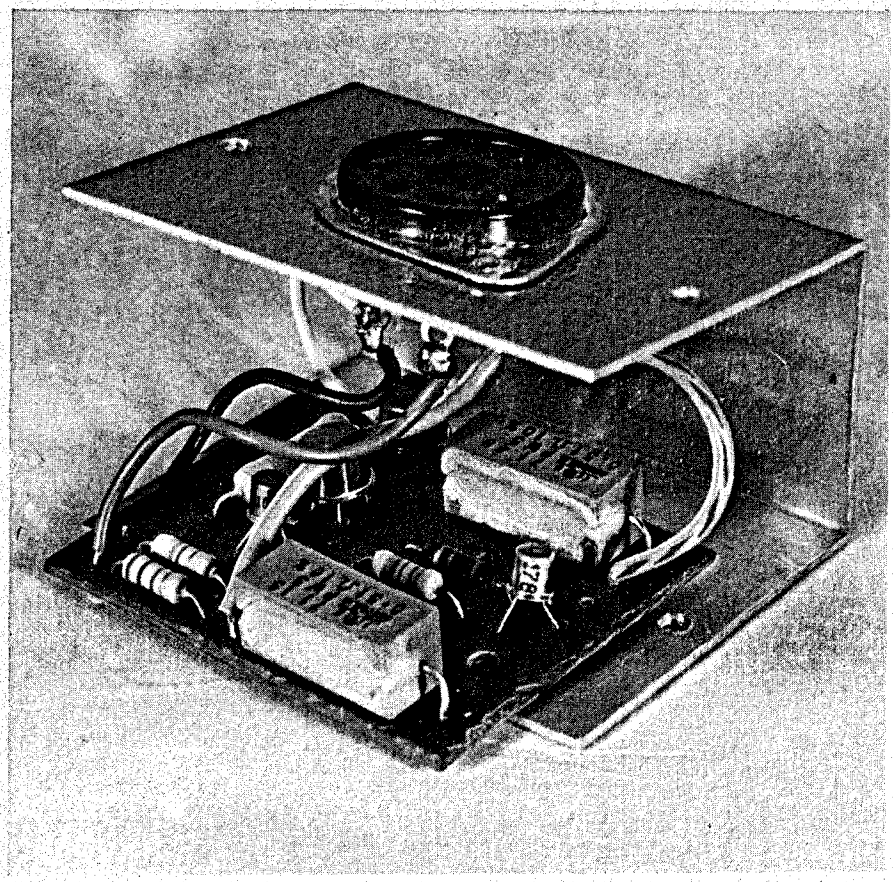
All vehicles

R1	—	resistor	0.51 ohms, 5 watt.
R2	—	"	" " "
R3	—	"	220 ohms, ½ watt, 5% (see text)
R4	—	"	100 " " " "
R5	—	"	470 " " " "
R6	—	"	" " " " "
R7	—	"	1.5k " " " "
R8	—	"	33 " 1 Watt "
R9	—	"	470 " ½ " "

PC board — ET 007, 1 metal case, wire, screws, grommetts etc.

These components will be generally available from the parts suppliers listed on page 118 of this issue.

BRAKE LIGHT WARNING



Here the assembled printed circuit board is ready to be located within the case.

HOW IT WORKS

Resistors R1 and R2 are in series with the brake lights. The voltage drop across them is proportional to the current through them, and if this voltage is high enough Q1 will be turned on via R4. When both brake lights are working the current is approximately 3½ to 4 Amps thus producing about one volt drop across the resistors.

This exceeds the base emitter voltage of Q1 and so Q1 and Q2 conduct, extending an earth to the indicator lamp which is thus energized.

In the modified circuit shown in Fig. 2 the earth to the indicator lamp is extended via 33 ohm resistor R8, thus giving a lower intensity than otherwise. However transistor Q3 is in parallel with *this resistor*, and, unless the sidelights are switched on, Q3 is biased on by R6. Thus in effect, Q3 shorts out R8 ensuring normal lamp brightness.

But if the sidelights are switched on, Q4 will be biased on via R7, and will clamp the base of Q3 to zero potential. Q3 will be switched off. Hence the full 33 ohms will appear in series with the indicator light, thus atuomatically reducing its brightness whenever the sidelights are on.

when the brake pedal is depressed, make sure that the ignition switch is on and that both brake lights really are working. Then make a thorough check of wiring both inside and outside the brake warning unit.

Indicator not extinguished when one rear light removed.

Firstly disconnect the lead to the rear brake lights from Pin 2 of the warning unit. If the indicator still does not extinguish, then the fault is within the unit; check internal wiring and transistor Q1.

If, one the other hand, the indicator goes out with the brake lights disconnected, check the number of lights connected in the brake circuit. Normally there is only one each side, each rated at approximately 2 Amps. The unit is normally set up for this load.

If there are more than two brake light globes, then for each additional globe a further 0.51 ohm resistor must be paralleled across R1 or R2. In other words the total number of 0.51 ohm resistors, must equal the total number of brake light globes.

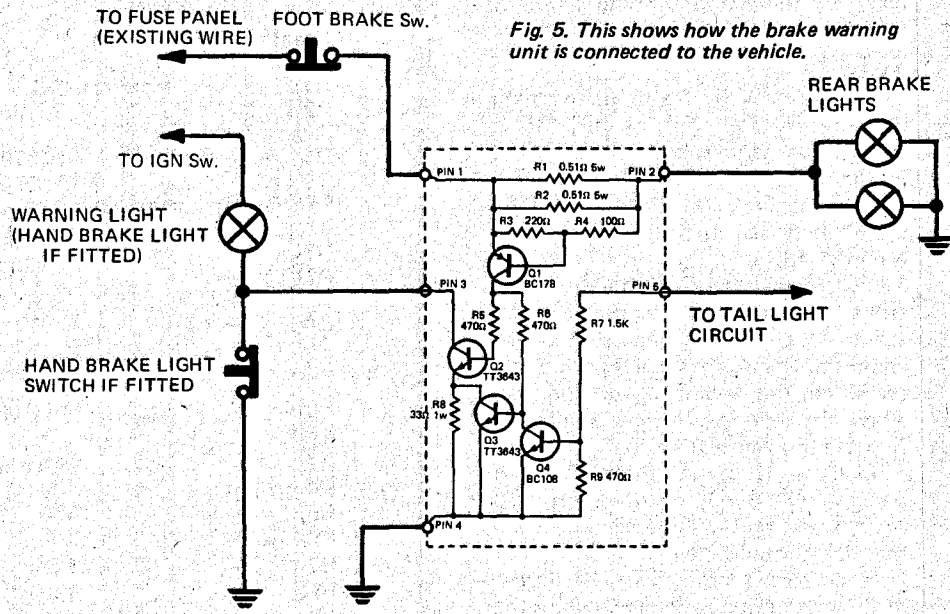


Fig. 5. This shows how the brake warning unit is connected to the vehicle.

Some vehicles use brake light globes of a rating other than the usual 18 or 24 Watts. If this is the case, solder resistor R3 (220 ohm) into place as shown in the circuit diagram.

If a trailer is to be used, a separate brake light circuit should be wired to the trailer socket bypassing the warning unit. If trailer brake light warning is specifically required, a second brake warning unit should be installed in the towing vehicle. ●

NEW ANTENNA

Revolutionary antenna design guides energy along air-earth or air-water interface

A new type of antenna, developed by A. F. Wickersham, of Menlo Park, California, could revolutionise point to point communications, particularly in the HF range.

These antennae launch electromagnetic waves such that they are "guided" by the surface of the earth, improving over-the-horizon performance of HF circuits that at present employ unreliable ionospherically reflected waves.

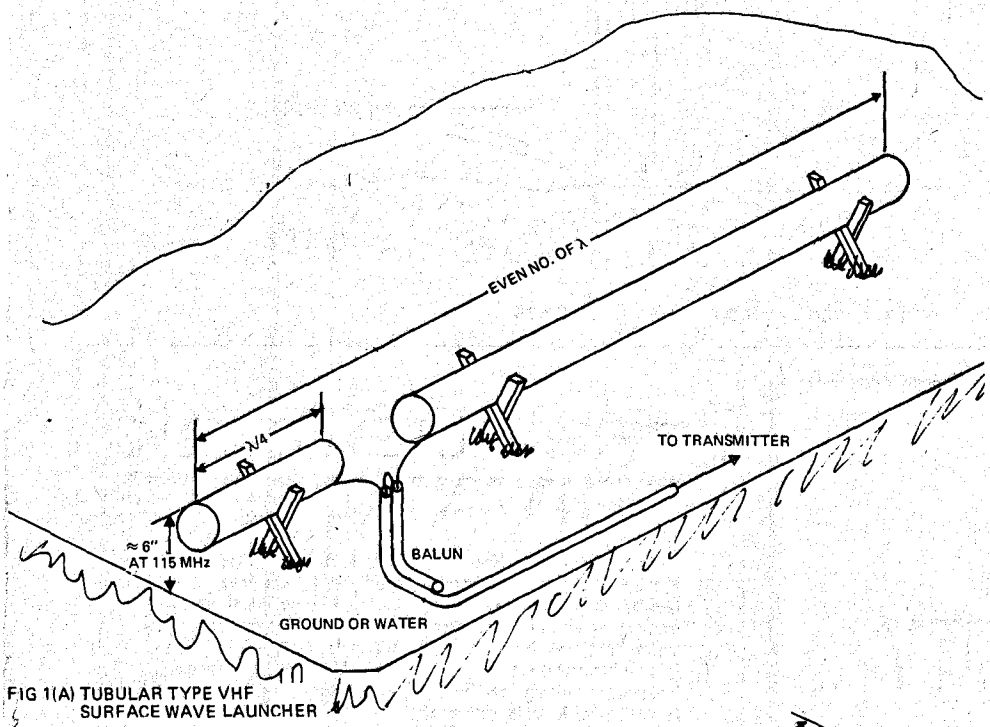


FIG 1(A) TUBULAR TYPE VHF SURFACE WAVE LAUNCHER

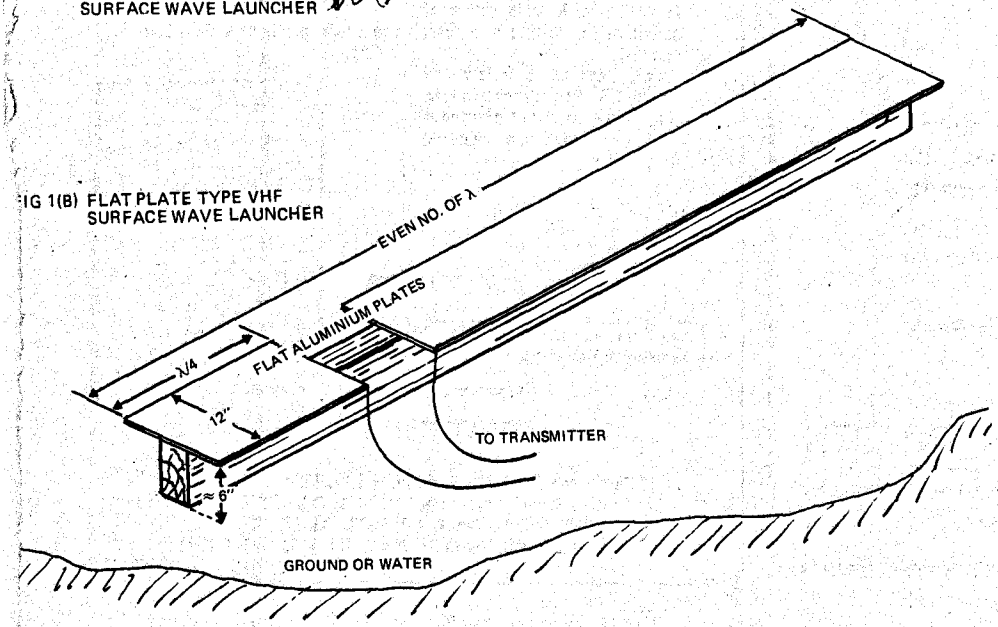


FIG 1(B) FLAT PLATE TYPE VHF SURFACE WAVE LAUNCHER

The designer predicts that using a power of 100 Watts and a surface wave launcher, received power, at a distance of 3,700 miles over seawater, would be at a level of 105 dBm a level easily handled by modern communications receivers.

The new antennae are of particular interest to short range VHF services as the launchers are mounted very close to the ground and the resultant surface wave propagation can be used to delimit the service area of a transmitter and reduce interference between neighbouring stations. They are also of interest to point to point services operating in the HF bands because this mode gives a rapid decrease in signal strength with increasing range from the transmitter (useful for short range working), and no fading is experienced on long range communications networks such as occurs when using ionospherically reflected sky waves.

VHF EXPERIMENTS

Most present antenna designs radiate electromagnetic energy in what is termed the Transverse Electro-Magnetic (TEM) mode. These new launchers are designed to radiate purely in the Transverse Magnetic (or TM) mode such that the energy is guided along the air-earth or air-water interface.

The attenuation of received power with range follows a predictable low for TM surface waves, being exponential over clay soil for ranges less than thirty wavelengths and inverse cubic for ranges greater than thirty wavelengths.

Over salt water the attenuation is exponential for ranges less than 250 wavelengths and the inverse cubic low starts beyond (approximately) 500 wavelengths. The signal actually increases between these two limits.

These results apply to launchers developed for uses at VHF. Two types are illustrated in Fig. 1. (a) and (b).

The feed point impedance varies with height above ground, being constant for heights over $\frac{\lambda}{8}$ (approximately) decreasing below this height, being near 50 ohms for heights around $\frac{\lambda}{16}$.

The flat plate type launcher has a greater bandwidth and improved effeciency (as much as 20 dB in received signal strength) over the tubular type of launcher.

NEW ANTENNA

HF EXPERIMENTS

Experiments carried out with a vertical launcher near 7 MHz have shown surprising results.

The signal attenuation followed an inverse quadratic law in this case, from close range to long range (beyond 100 miles).

The constancy (lack of fading) of received signal strength at long ranges was very good. Compared with ionospherically reflected signals, the reliability of the surface wave (TM) mode of propagation is excellent.

By using this type of propagation it will be possible to predict what the received signal strength will be at a given range for a given transmitter output power. The result will be a vast improvement in communications circuit reliability.

The transmitting antenna used for the HF tests was a vertical dipole with the lower limb buried in wet sand. The upper limb was a quarter wavelength (in air) long, the lower limb in a quarter wavelength (in wet sand). Receiving antennas were identical. ●

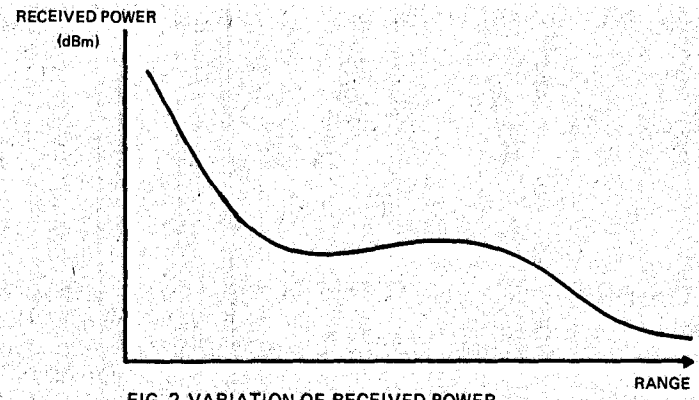


FIG. 2 VARIATION OF RECEIVED POWER VERSUS RANGE (VHF/EXPERIMENTS)

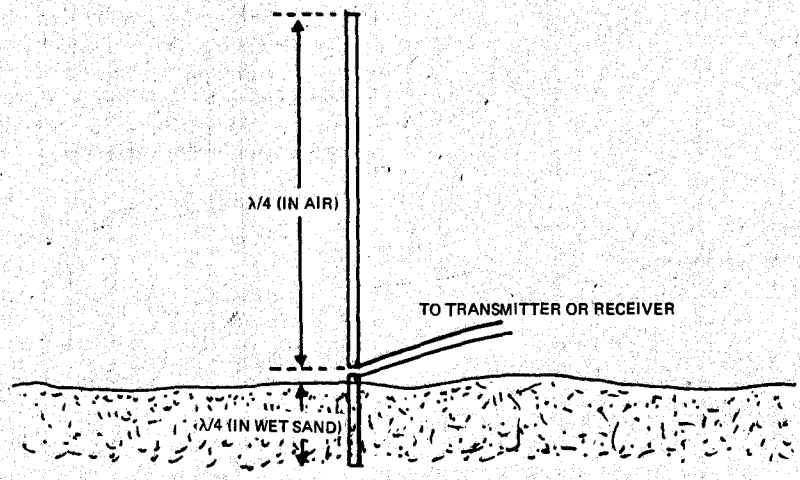
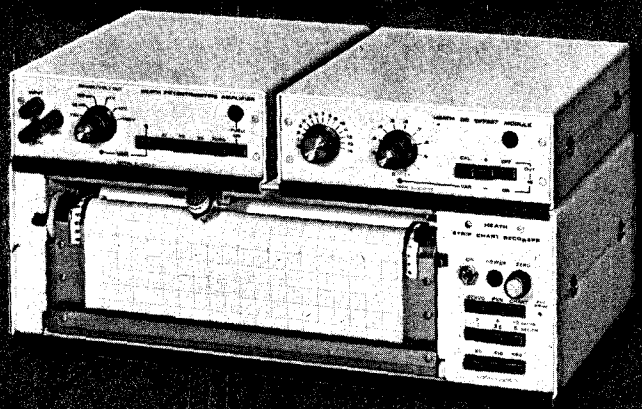


FIG 3 ANTENNA USED FOR HF EXPERIMENTS

CAREFUL!

THIS SCHLUMBERGER ADVERTISEMENT CONTAINS USEFUL INFORMATION



New Schlumberger/Heath model EU205B chart recorder featuring:—

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- Completely programmable.
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- 18 caliabrated and continuously adjustable ranges 1mV - 500V.
- 15 full scales of offset on all ranges.
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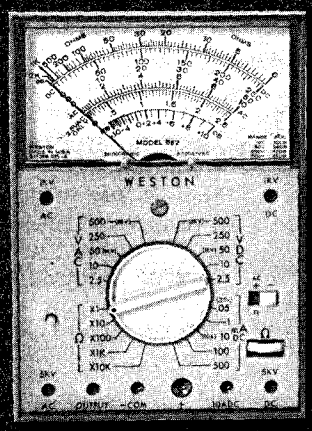
- Floating input.
- 20" per second writing speed.



New Schlumberger/Weston 660 VOM series. Model 666 features:—

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- FET input—10MΩ input impedence.
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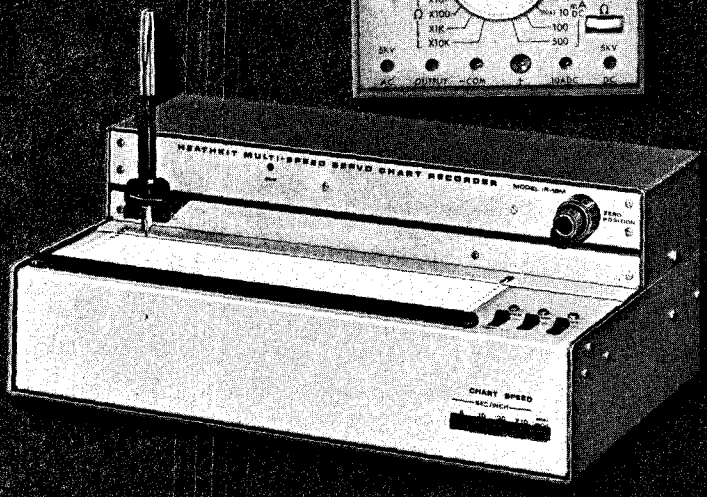
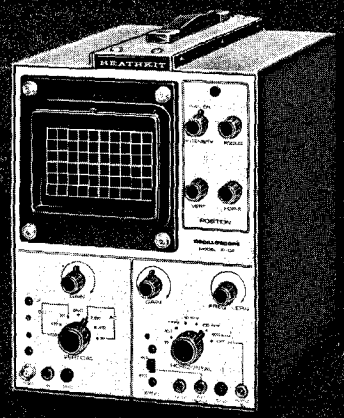


New Schlumberger/Heath model IR-18M chart recorder features:—

- 12 chart speeds 5 seconds/inch to 200 minutes/inches.
- Two ranges 1mV and 10mV full scale.
- High input impedence.
- Floating input.



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Even so, the saving is just beginning—because when you get a really great amplifier at this price, you can spend more on those better speakers you've had your ear on.

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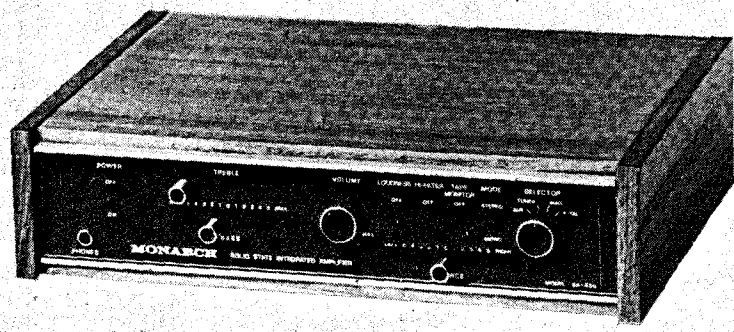

[illegible] Recommended Retail Price $107.

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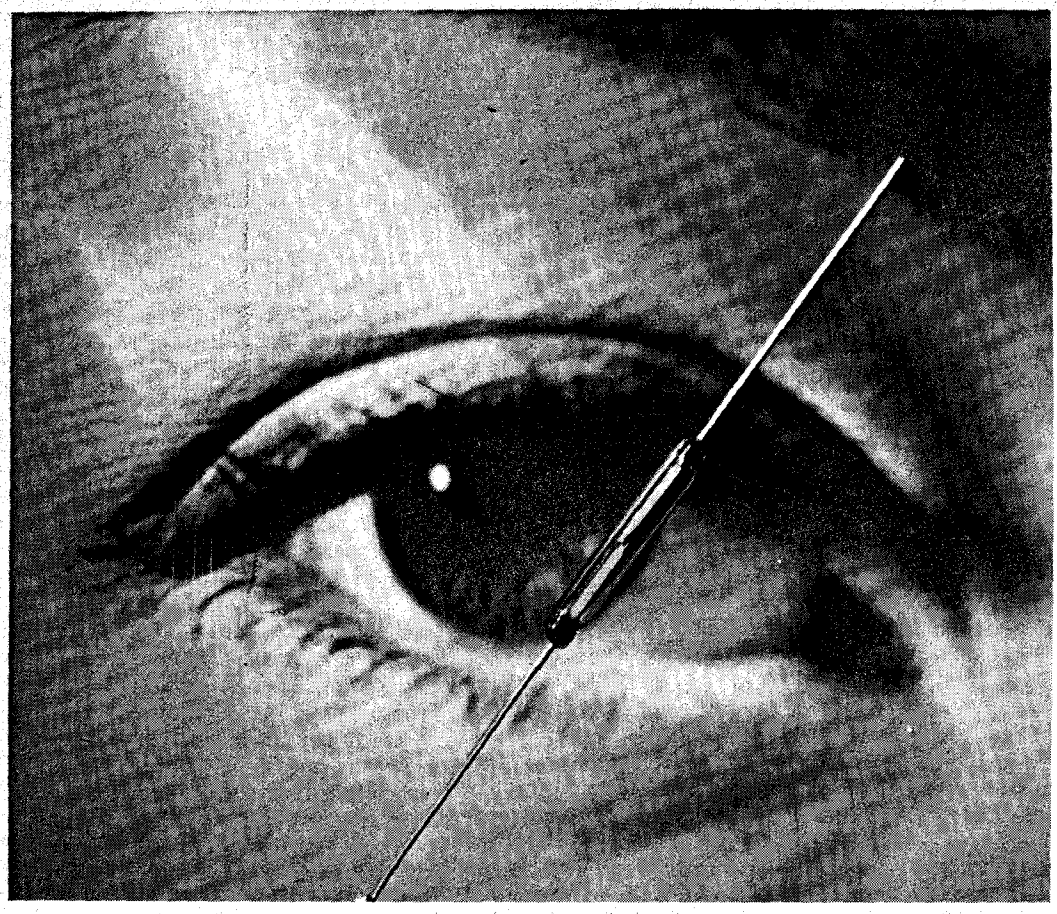
QLD. Tel-Air Electronics, 187 George Street, Brisbane. 4000.

W.A. Leslie Leonard, London Court, Perth. 6000

TAS. P&M Distributors, 87 Brisbane Street, Launceston. 7250

S.A. Sound Spectrum, 33 Regents Arcade, Adelaide. 5000

PRACTICAL GUIDE TO REED SWITCHES



PART 2

In the second article in this series, Collyn Rivers explains how reed switches may be electrically actuated.

REED switches are actuated by a magnetic field.

This field can be generated by a permanent magnet, or by an electrically energised coil. When coils are used, the reed switch is simply inserted within the coil former and it is then closed (or opened) when current is passed through the coil.

It operates, in fact, as a relay, and in this form reed switches are used by the million, in telephone systems around the world.

When a reed switch is to be electrically actuated, an indication of the magnetic field strength that is required is generally quoted by the manufacturer in terms of so many ampere-turns. This figure may range from 50 AT to 250 AT (but as

Turns		7,520		9,600		11,900		15,000		19,500		25,000		36,000		43,100		53,000		66,500		86,800	
Ohms		219		355		550		855		1,390		2,380		4,320		6,380		9,900		16,000		25,000	
Switch Sensitivity	50AT	1.5	6.5	1.8	5	2.3	4.2	2.8	3.3	3.5	2.5	4.8	2	6.1	1.4	7.3	1.2	9.4	0.8	12	0.75	15.7	0.6
	100AT	3.0	13	3.6	10	4.6	8.4	5.7	6.7	7.1	5.1	9.5	4	13	2.8	14.7	2.3	19	1.9	24	1.5	31	1.2
	150AT	4.5	20	5.3	15	6.9	12.6	8.5	10	11	7.6	14	6	18	4.2	22	3.5	28	2.7	36	2.3	47	1.8
	200AT	6.0	26	7.0	20	9.2	17	11	13	14	10.2	19	8	24	5.6	29	4.6	38	3.8	48	3.0	94	2.4
	250AT	7.5	33	8.8	25	11.5	21	15	16	18	12.7	24	10	30	7.0	37	5.8	47	4.6	60	3.8	110	3.0
		v	ma	v	ma	v	ma	v	ma	v	ma	v	ma	v	ma	v	ma	v	ma	v	ma	v	ma

Table 2. Data for standard size reed switch operating coils — bobbins to be 2" long x 0.220" inside diameter, winding build up will be approx. 0.2".

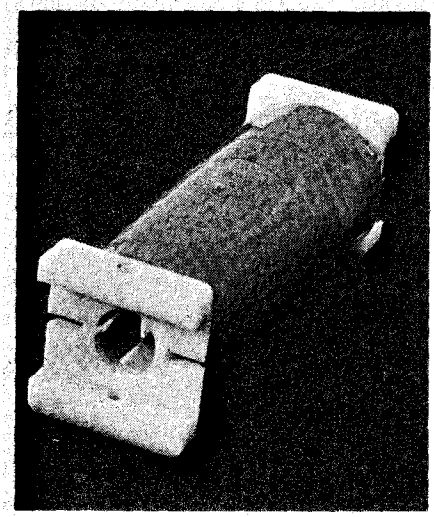


Fig. 11. Bobbin for standard sized reed switch.

explained later, this may be substantially reduced by the judicious positioning of a bias magnet).

Various combinations of turns, wire sizes and dimensions may be used to close any specific type of switch, and these parameters will in turn be determined not only by the required number of ampere-turns, but also by the circuit voltage and current that is available. For example a switch that requires 100 ampere-turns may be actuated by a 220 ohm winding drawing 13 mA at 3.0 V., or by a 25,000 ohm winding drawing 1.2 mA at 31 V.

Table 2 provides all the data required to design operating coils for a wide variety of standard sized reed switches, (i.e., 2.75" overall, 2.0" long, 0.217" diameter).

The operating coil may either be wound on a bobbin manufactured specifically for the purpose (Fig. 11) or made up from a length of paper, aluminium or plastic tubing that is a neat fit over the outside diameter of the glass reed.

Another method of making operating coils is to wind them, using a cement coated wire, onto an arbour that is shaped to create the desired final

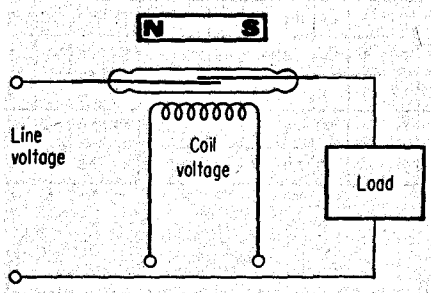


Fig. 12. Magnet assists reed switch to close, and thus reduces coil energy requirement.

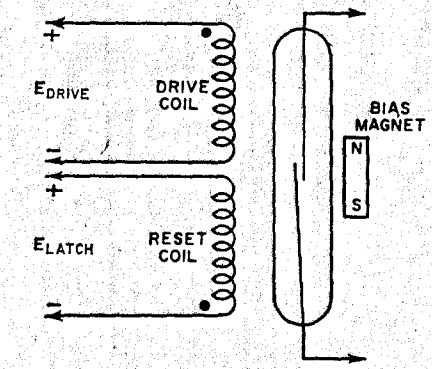


Fig. 13. In this circuit, reed switch is latched by aiding permanent magnet, and reset by magnetic opposition from reset coil field.

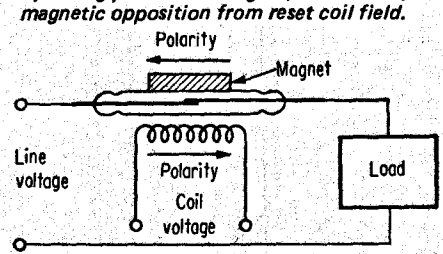


Fig. 14. Normally closed operation using magnetic bias.

Fig. 15. This type of reed switch may be used for either change-over or normally closed operation.

form. After removal from the arbour, the winding should be protected by a layer of insulating tape.

EXTERNAL MAGNETIC FIELDS

A reed switch is influenced by a magnetic field regardless of whether that field is produced by the operating coil or by some other magneto-motive force. The magnetic force generated by the field winding can be modified or even completely cancelled by the field from a nearby permanent magnet, or by the alternating flux from a nearby choke, transformer or other inductive device. Even the proximity of a sheet steel chassis may affect the energy at which a reed switch will just actuate.

But the effect of external magnetic influences may be usefully exploited to modify the characteristics of the basic reed switch assembly.

For example the ampere-turns required to close any given switch, can be halved by placing a magnet a short distance away from the coil – the magnet's polarity must be the same as that of the operating coil. The positioning of the magnet is fairly critical and is best determined by trial and error, (Fig. 12).

A similar method can be used to obtain a latching action. In this case the method exploits the magnetic hysterisis of the reed switch. The magnet is placed far enough away from the coil so that it does not close the reeds magnetically, but sufficiently close so as to hold the reeds closed once they have been actuated by an electrical signal through the coil.

In this example the reed relay can be unlatched only by physically removing the magnet, or by applying opposite polarity drive through the operating coil.

A further modification of the magnetic latching principle is shown in Fig. 13. Here, whilst magnetic latching is still used, the operating coil has two windings, one of which is used to actuate the relay, and the other, which is connected in opposite polarity, is used to unlatch the relay.

A magnet may also be used to convert a normally open reed relay to normally closed operation. This is done by locating the magnet sufficiently close to the reed so that the contacts are held closed. (Fig. 14). The coil is wound so as to produce a magnetic flux of opposite polarity to the magnet. When the operating coil is energised, the resultant magnetic flux will cancel out that from the permanent magnet, and the reed will open.

Change-over action may be obtained either by using a reed switch specially made for the purpose (Fig. 15) or by using a magnet and two normally open reed switches actuated by a common operating coil (Fig. 16).

It is possible to actuate a number of separate reed switches located inside one large operating coil, but due to variations in the sensitivity between one reed and another, and the positioning of individual reed switches within the operating coil, it is not possible to predict the contact action sequence. All other things being equal the most sensitive reed will operate first. This will then act as a magnetic shunt, retarding the operation of the remaining reed switches. This is a major difference from conventional electro-mechanical relays where a single armature or card drives all of the movable contacts and any pair of contacts can be adjusted to ensure synchronous operation or a specific contacting sequence.

Nevertheless if a current at least

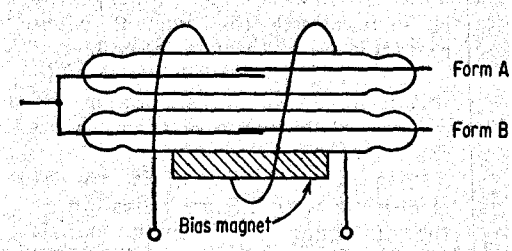


Fig. 16. Change-over action may also be obtained by combining a magnet and two normally open switches actuated by a common operating coil.

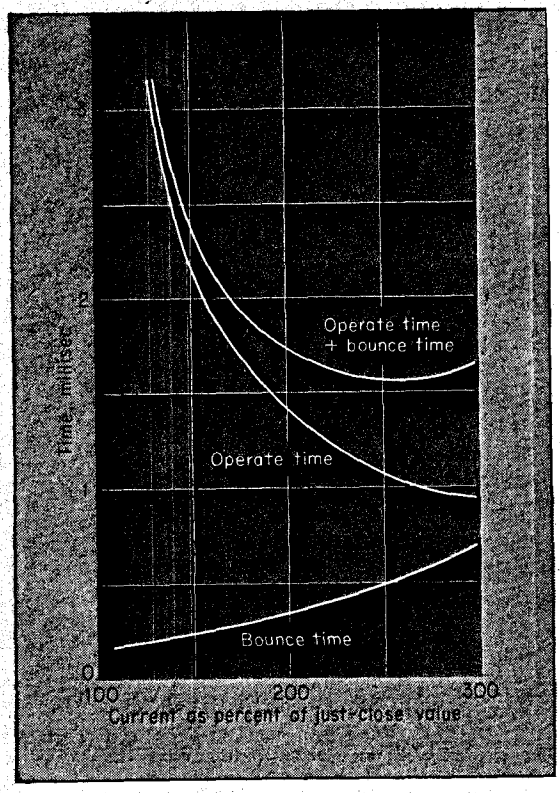


Fig. 17. Variation of operate and bounce time with energizing current.

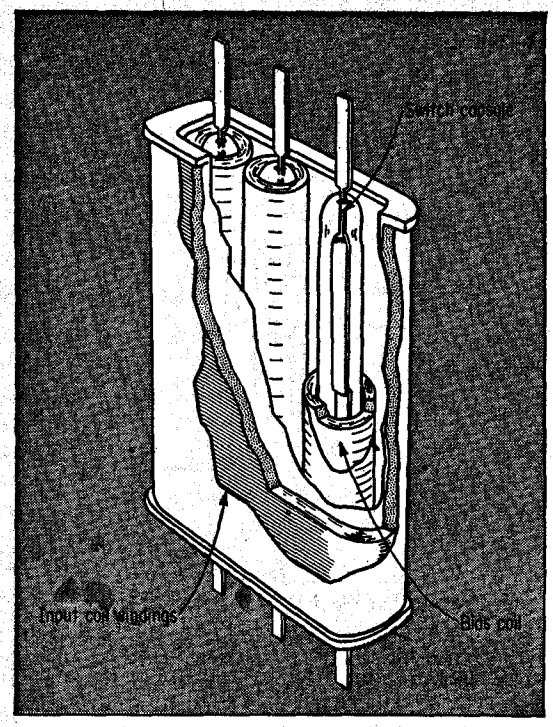


Fig. 18. Reed switch logic module.

150% of the just-operate ampere-turns of the highest rated switch of the group is applied suddenly, this effect is less noticeable, and in most applications may be virtually neglected.

SWITCHING CHARACTERISTICS

The moving blades inside a reed switch have very low mass and move only a few thousands of an inch. The operating coil is not iron cored and so has little self-inductance thus allowing a magnetic field to build up very rapidly. These factors combine to ensure that a reed relay is an inherently quick-acting device, in fact, operating times of less than one millisecond are quite typical.

The speed at which any specific reed relay closes is primarily a function of the number of ampere-turns in the operating coil. But when the contacts close they normally bounce two or three times and the harder the relay is driven (i.e., the greater the number of ampere-turns) the greater the number of times that the contacts bounce. In general reed relay coils are designed so that nominal rated voltage produces approximately 50% more ampere-turns than the just-operate value. This gives optimum total operate time including the contact bounce time. (Fig. 17).

After the contacts have closed and have stopped bouncing, the reeds continue to vibrate for a short time. This vibration produces magnetostriction contact noise — a damped oscillatory voltage that decays to zero — and this may cause problems in low signal level circuits.

With no suppression devices across the operating coil, reed release time is very fast — it may be as short as 25 micro-seconds. Adding a suppression diode has little, if any effect on the operate or bounce times, but it does significantly lengthen the release time. For example, the release time of a standard type of reed without a suppression diode may be 50 micro-seconds, but with a diode the release time may be extended to a milli-second or so.

Due to the geometry of the reed switch construction, the capacitance between contacts is low, and with standard sized reed relays this will be about one pico-farad. The capacitance between the reeds and the operating coil will be about 2.5 pico-farads but this can be reduced to approximately 0.5 pico-farads by interposing a grounded electrostatic shield between the coil and the reed.

Some thermal EMF will be generated at the junction of dissimilar metals in reed switches due to the heating produced by energizing the coil. This thermally-generated EMF may be undesirable if the reeds are used to switch low level analogue signals — as for example in data-logging or thermocouple measurements.

For applications where the thermal EMF must be held to the minimum a bi-stable latching reed relay should be used. A short pulse to the set coil operates the relay, no heat generating holding current is then required. Another short pulse to the reset coil releases the relay. Using this type of operation, the latching relay thermal EMF remains below five micro-volts, compared to as much as 100 micro-volts for continuously energized relays.

REED SWITCHES AS LOGIC ELEMENTS

The reed relay is almost an ideal buffer between solid state devices and higher power output elements. The winding impedance and current levels is well suited for the collector or

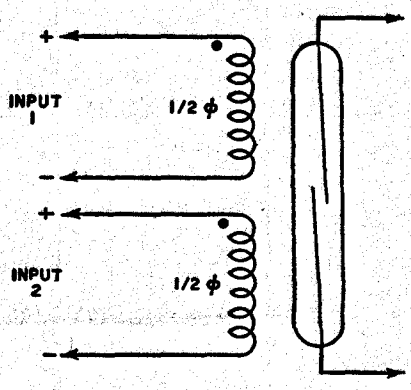


Fig. 19. The reed relay as an AND gate. Each coil can produce ½ a 'flux unit', and an output is obtained only when voltages are applied to inputs.

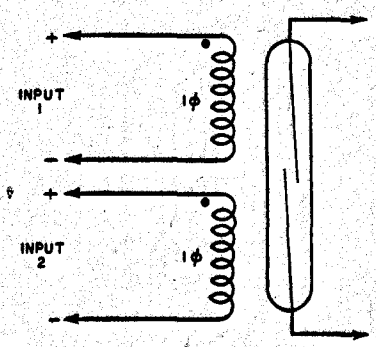


Fig. 20. Reed relay OR gate. Either coil can close reed switch.

emitter circuits of standard transistors, and it can also be driven by many IC elements.

With the recent introduction of the 'pico-reed' switch, a single pole relay is now available in a dual-in-line package, making it both physically and electrically compatible with integrated circuit components. And as reed relays become smaller their operating speeds increase, so that a pico-reed relay can be made to follow 1 kHz pulses.

Reed switches are finding increasing use as logic elements for use in adverse environments. They are capable of performing a large variety of logic functions including AND, OR, EXCLUSIVE OR, and NOT operations. The relays can be used to construct flip-flop circuits, and these can be used in binary, binary coded decimal and decimal counters, ring counters, up-down counters and shift registers.

Whilst operating speed is very considerably slower than with solid state logic elements, there is not the same necessity for precise voltage and frequency regulation, nor the susceptibility to voltage transients. And for these reasons reed relay logic circuits are becoming increasingly used in industrial equipment.

A wide range of reed relay logic elements are commercially available — generally in a configuration similar to that shown in Fig. 18. The individual reed switches are surrounded by bias coils, and these in turn share a common input winding coil. By adjusting the ampere turns level to both input winding and the individual bias windings, a multiplicity of functions can be obtained. A permanent magnet can also be used in this type of logic element to provide memory or latching functions.

When designing reed relays as logic elements, the amount of magnetic flux that is required to close the relay is regarded as one flux unit. Thus a two input AND gate consists of one reed switch surrounded by two windings each of which can generate one half a 'flux unit'. (Fig. 19).

It is possible to expand the concept to produce three, four or five input AND gates by providing a separate winding for each input, such that each winding provides $\frac{1}{n}$th of the total required flux.

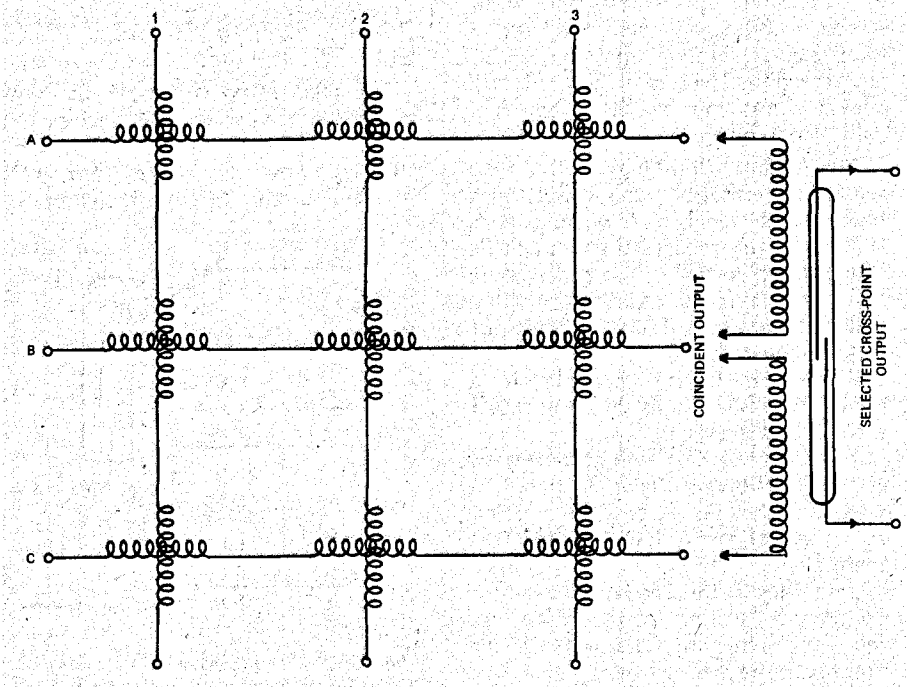


Fig. 21. Cross-bar matrix switching, the appropriate relay will close whenever both coils of any given relay are coincidentally energised.

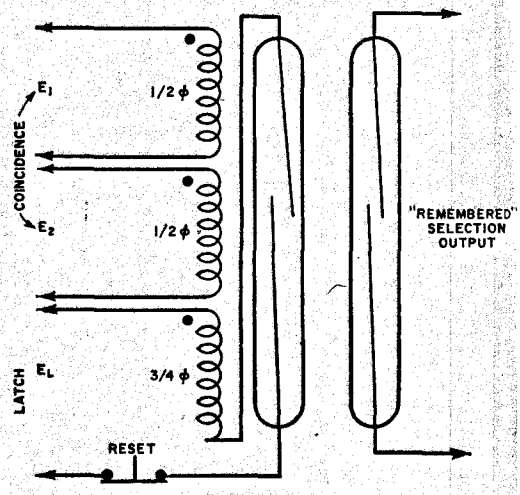


Fig. 22. How a 'memory' may be incorporated in a matrix element.

An OR gate is produced by providing two windings either of which can be energised to the level of one flux unit, (Fig. 20). Thus a voltage in either winding can cause the relay to close. Again, as with the AND gate, a number of windings may be used provided each one can provide one full flux unit.

The basic OR gate can be used as an exclusive OR gate simply by reversing the direction of one winding. In this application if either one or the other winding is energised then the relay will close, but if both are energised then the resultant magnetic fields will cancel out and the relay will remain open.

Inverted operation is provided by using relays that are magnetically biased into normally closed operation.

Cross-bar matrix switching is readily achieved by using a double wound relay, in which each winding provides half a flux unit, at each selection point, i.e., A1, A2, A3, etc., (Fig. 21). The appropriate relay will close whenever both coils of any given relay are coincidentally energized.

The cross bar switching system may be used with a magnetic or electrical memory if required. Fig. 22 shows how two reed switches can be used, together with a latching winding, to provide an electrical memory in a reed relay cross bar switching system. In this form the matrix will remember the inputs after they have been removed, until the latching power supply is interrupted.

The final article in this series, which will be published next month describes a number of ways in which reed relays are used in sophisticated equipment.

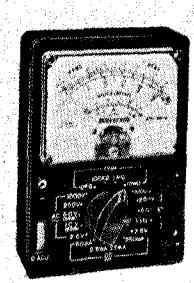
University

Diode Protected, General Purpose Multimeters

All backed by "UNIVERSITY" sales, spare parts & service.

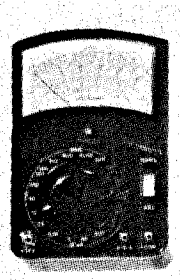
MODEL MVA–100 Multimeter.
D.C.V.: 0.5-2.5-10-50-250-500-1000 (100KΩ/V).
A.C.V.: 2.5-10-50-250-1000.
D.C.A.: 10μA-250μA-2.5mA-25mA-250mA-10A.
A.C.A.: 0-10A.
Ohms: 20K-200K-2M-200M.
db: –20/0/+62.
Price each: $35.00 + 15% S.T.

Features: 100KΩ/V – 10 A.A.C. – 200MΩ Res.



MODEL MVA–4 Multimeter.
D.C.V.: 2.5-10-50-250-1000 (20KΩ/V).
A.C.V.: 2.5-10-50-250-1000 (8KΩ/V).
D.C.A.: 50μA-2.5mA-25mA-250 250mA.
Ohms: 10K-100K-1M-10M.
db: –20/0/+22.
+22/+36.
Price each: $16.00 + 15% S.T.

Features: Metal Case back – Low Price.



MODEL CT-500 Multimeter.
D.C.V.: 2.5-10-50-250-500-5K (20KΩ/V).
A.C.V.: 10-50-250-500-1K (10KΩ/V).
D.C.A.: 50μA-5mA-50mA-500mA.
Ohms: 12K-120K-1.2M-12M.
db: –20/0/+62.
Price each: $14.00 + S.T.

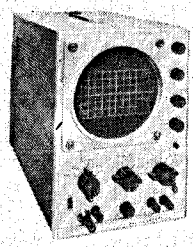
Features: 500mA D.C. – Mirror Scale – Low price.

MODEL MVA–5 Multimeter.
D.C.V.: 5-25-50-250-500-2.5K (20KΩ/V).
A.C.V.: 10-50-100-500-1000 (10KΩ/V).
D.C.A.: 50μA-2.5mA-250mA.
Ohms: 0.6K-6M.
db: – 20/0/+22.
Price each: $10.00 plus 15% S.T.

Features: Colour Scale – Single output socket.

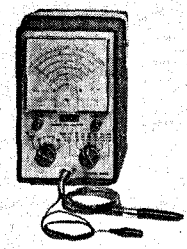
University TEST EQUIPMENT

Also backed by "UNIVERSITY" sales, spare parts & service.



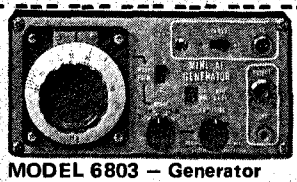
MODEL UC5 5" Oscilloscope.
Vertical: 10mV P.P./cm.
Freq. Range: D.C. to 10 MHz.
Horizontal: 300mV P.P./cm.
Wide Sweep 1Hz to 200 KHz.
Continuously variable.
Price each: $250.00 + 15% S.T.

Features: D.C. to 10 MHz – 5" Screen.



MODEL MVA–6 vacuum tube Voltmeter.
AC-DC Volts, 7 ranges to 1.5KV; P.P. volts, 7 ranges to 4KV.
db (1mW-600) – 10db to + 65db;
Ohms .2 to 1000M.
Price each: $48.00 + 15% S.T.

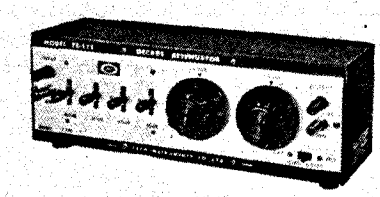
Features: Colour Scale – Single output socket.



MODEL 6803 – Generator

Frequency Coverage:	10Hz – 100kHz in 4 bands continuously variable.
Waveform:	Sine and Square waves
Frequency Accuracy:	± (2% + 1 Hz)
Max. Output (600Ω load):	+ 9dBm or more, continuously variable with variable resistor
Output Impedance:	600Ω ± 100Ω unbalanced
Output Frequency Response:	± 1 dB at 1 kHz
Distortion Factor:	Less than 0.3% 200Hz-100kHz Less than 0.8% 10Hz-100kHz
Square Wave Risetime:	0.2μS
Power Source:	100–115VAC or 220–240VAC, 50/60Hz (approx. 3VA)
Dimensions:	190(L)x95(W)x100(H)mm

Features: Solid State – small size



MODEL RA-111 Decade Attenuator

Range:	0.1db–111db. (DC to 150KHz)
Connection Systems:	Unbalanced T & Bridge T.
Impedance:	600Ω
Range:	(0.1db x 10) + (1db x 10) + 10 + 20 + 30 + 40db.
Measuring Frequency:	D.C. – 200KHz (–3db)
Accuracy:	0.05db + indication db x 0.01
Maximum Input:	Less than 4W (around 50V)
Additional device:	600Ω load resistance with internal, external change over switch built-in.
Dimensions:	12" x 4½" x 4"

Features: Ease of operation

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Also available from all leading wholesalers

AUDIO-VISUAL METRONOME

This simple electronic metronome sounds just like its mechanical counterpart — and has a visual output as well!

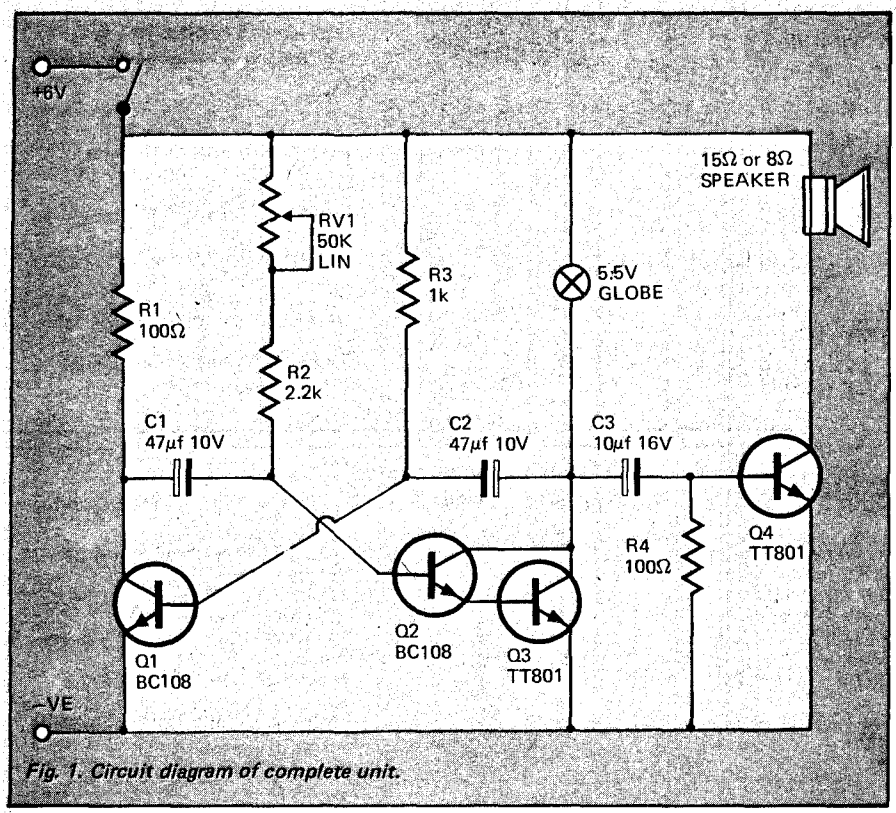


Fig. 1. Circuit diagram of complete unit.

When Maelzel invented the clockwork metronome about 170 years ago, his device indicated the tempi in music both audibly and visually.

Today's electronic counterparts rarely have visual outputs, and even the audio signal is quite unlike the 'tic' sound characteristic of the mechanical instruments.

But here's one with a difference.

The beat rate of this simple electronic metronome may be varied from adagio to allegro as required. The unit realistically simulates the 'tic' of the conventional clockwork units, and also flashes a light in time with the beat. This latter feature is of considerable value especially in school classrooms.

CONSTRUCTING THE UNIT

The circuit diagram of the unit is shown in Fig. 1.

Component layout is not at all critical and the unit may be assembled using tag strips — as shown in Fig. 2 — or on perforated board, or, if a completely professional appearance is required, a printed circuit board may be used.

The choice of loudspeaker, again, is not at all critical, and any eight or 15 ohm unit not exceeding four or five inches in diameter may be used.

The size of the loudspeaker and the choice of battery will probably determine the method of housing the main components. One simple way is to locate the electronic components and batteries inside an extension loudspeaker enclosure. The flashing light may then be mounted on the front face of the completed unit.

An alternative method of using the flashing light is to locate it away from the main unit. This is a valuable feature if the unit is used for instruction in school classrooms (an application we had in mind when building the prototype unit).

PARTS LIST

R1	—	resistor 100 ohm, ½ watt, 5%
R2	—	" 2.2k, " "
R3	—	" 1.0k, " "
R4	—	" 100 ohm, " "
RV1	—	potentiometer 50k, linear, ½ watt
C1	—	capacitor, electrolytic 47μf, 10 volt
C2	—	" " " "
C3	—	" " 10μf, 16 volt
Q1	—	transistor BC108 or equivalent.
Q2	—	" " "
Q3	—	" TT801 or equivalent.
Q4	—	" " "
SW1	—	single pole, single throw switch
Speaker	—	8 ohm or 15 ohm speaker 1" — 5" diameter
Globe	—	5.5 volt, up to 500 mA.

ET PROJECT

THE UNIT IN USE

Having completed the assembly, check over all connections for wiring errors, and then connect the unit to a six volt battery — an Eveready type 713 will power the unit for several hundred hours.

Turn RV1 fully anticlockwise and switch SW1 to ON. The loudspeaker should now tick at a very slow rate, and the lamp should flash in unison (if it does not do so, switch off and check all connections carefully).

Now turn potentiometer RV1 until the metronome produces the lowest beat rate required (i.e. adagio) and mark this point on a scale attached to the face of the instrument. Further points should be marked on the scale by checking the metronome against a stopwatch or another accurately calibrated metronome.

It is advisable to check the calibration occasionally — this is done simply by setting the unit to the lowest point marked on the scale — i.e. adagio — and checking the rate against a stopwatch.

But as the beat rate of the circuit is not affected by changes in battery voltage from 6.5 volts down to less than 5.5 volts, and because of this it is not necessary to calibrate the unit each time that it is used.

As a matter of interest the word 'metronome' is derived from the Greek metron (measure) and the Greek nomos (law). There is no truth in our London correspondent's theory that the unit was named after a very small man who once worked on the Paris underground railway. ●

HOW IT WORKS

Transistors Q1 and Q2 form a free-running multivibrator, the frequency of which is varied by potentiometer RV1. The output waveform is amplified by Q2 and Q3 which are connected as a Darlington pair.

The flashing light is driven by Q3, the on time of this lamp is approximately equal to $\frac{R3 \times C2}{10^6}$ seconds. the time off is approximately $\frac{(R2 + RV1)}{10^6}$ C1 seconds.

The output square wave from the multivibrator is differentiated by C3 and R4 and then amplified by Q4. The loudspeaker forms the collector load of Q4.

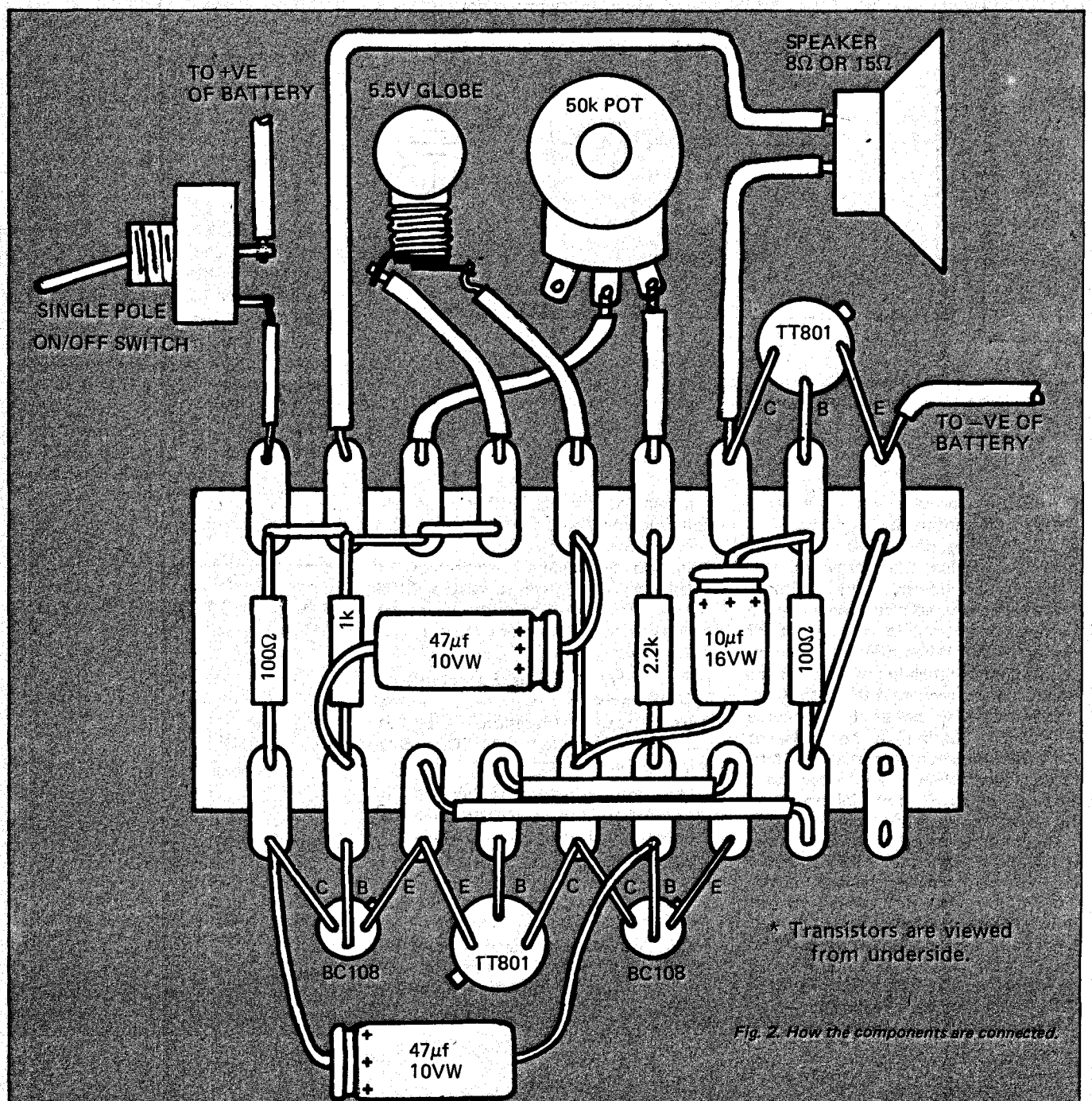
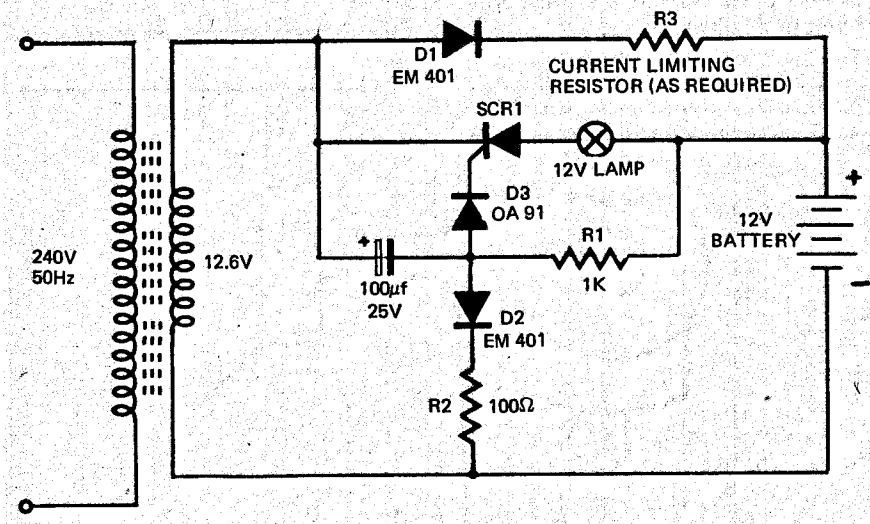


Fig. 2. How the components are connected.

EMERGENCY LIGHTING UNIT

This simple versatile circuit has many uses



The 12 volt lamp shown in this circuit should be rated at 12 watts or less — this may be increased to 24 watts if the SCR is mounted on an adequate heat sink.

HERE's a project with any number of different uses.

Basically it's a 240 volt mains operated device that provides low voltage dc power, and switches instantaneously and automatically to battery operation in the event of power failure. When power is restored the unit automatically reverts to mains operation and recharges the battery.

The unit may be used to provide emergency lighting in hospitals, or dark corridors, as an automatic battery change-over supply for intruder alarm systems, or as a power failure alarm for heaters or deep freeze systems.

The circuit may be used in many different forms with circuit component values and battery ampere/hour capacity chosen to suit individual applications.

Figure 1 shows a circuit designed to supply 12.0 volts at 1.0 Amp, this may be increased to at least 2.0 Amps if the SCR is mounted on a heat-sink.

Transformer T1 is a standard filament transformer with a secondary winding capable of supplying 12.6 Volts rms. Any SCR capable of handling a couple of Amps may be used for SCR1. We suggest a C106 series, primarily because they are generally available from most parts suppliers.

In theory, capacitor C1 should be non-polarised because, during emergency operation, it is reverse-charged to the SCR gate triggering voltage.

This rarely exceeds half a volt and in practise standard electrolytics may be used without fear of breakdown.

Resistor R3 must be chosen to limit the charging current of the battery to a safe level. This level varies from one type of battery to another — most nickel cadmium batteries, may be trickle charged continuously at 1/100th of their Ampere/hour rating — i.e., a one A/h battery may be continuously charged at 1/100th of an Amp = 10 mA.

The value of R3 may be calculated as:—

$$R3 = \frac{Vs - V_B}{Ic} \times 1000$$

Where Vs = Supply voltage from transformer
V_B = Battery voltage
Ic = Charging current in milliamps

If in doubt, the maximum safe continuous charging current can be ascertained from the supplier or manufacturer of the battery that you have chosen.

To modify the circuit for other applications it is necessary to choose a transformer having an output about 5 or 10% higher than the standby battery, and rated to provide the load current required. The SCR must also be chosen with voltage and current ratings suited to the application.

HOW IT WORKS

When ac power is on, the battery is trickle charged through diode D1. At the same time the 100 uF capacitor charges through D2 and discharges through R1 and the battery, and, because the discharge time constant is longer than the charge time constant, the SCR gate is reverse-biased.

If ac power fails, the capacitor discharges completely, and the battery will then charge the capacitor in the opposite direction until the voltage is sufficient to trigger the SCR (typically 0.6 Volt). At this point the SCR triggers and supplies power to the emergency light.

The circuit is reset automatically when power is restored.

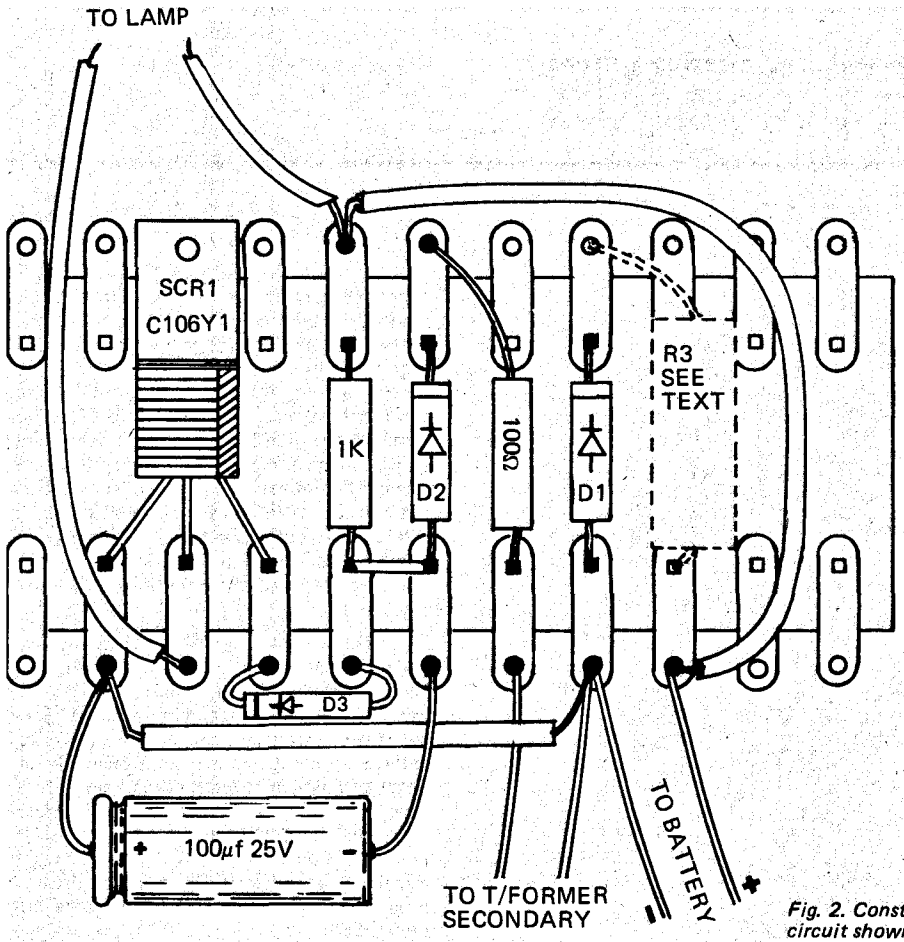


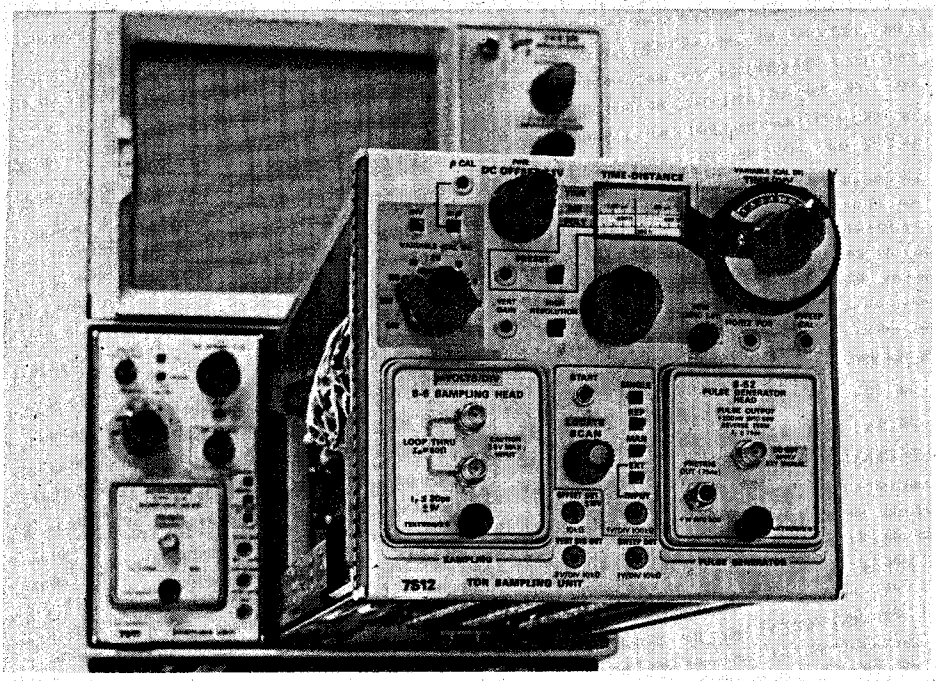
Fig. 2. Constructional details of the circuit shown in Fig. 1.

PARTS LIST

R1 —	resistor, 1k, ½ Watt, 5%.
R2 —	resistor, 100 ohm, ½ Watt, 5%.
R3 —	resistor, see text.
C1 —	capacitor, electrolytic, 100uF, 25 Volt.
D1 —	silicon diode, EM 401 or equivalent.
D2 —	silicon diode, EM 401 or equivalent.
D3 —	germanium diode OA91 or equivalent.
SCR1 —	silicon controlled rectifier C106 Y1 or equivalent.
Txf —	filament transformer — 240 volt to 12.6 volt at 1½ Amps.
Battery —	12 Volt nickel cadmium or lead acid battery — size to suit application.

EQUIPMENT NEWS

TIME DOMAIN REFLECTOMETER



Tektronix Australia Pty. Limited announces the 7S12 Time Domain Reflectometer, an oscilloscope plug-in unit that fills three measurement needs.

1. Hi-Resolution TDR-45 picosecond T_R
2. Long-Line TDR – up to 9800 feet
3. General Purpose Sampling – 35 picosecond T_R

The 7S12 is a double-width plug-in designed for the 7000-Series Oscilloscopes. The Tektronix interchangeable sampling head concept is used to achieve application flexibility. One of the two heads in the 7S12 serves to accept and process incoming signals for display in the vertical axis. The second head generates the incident pulse for TDR or serves as a trigger recognition device in general purpose applications. The 7S12 is uniquely designed to work with other sampling plug-ins to provide dual sampling displays.

The 7S12 TDR features a vertical system calibrated in volts or rho. Reflection coefficients as low as 0.001 can be observed. Signal averaging reduces test-line noise. A unique tape dial permits direct reading of time or distance. A locate button provides instant return to a complete display of the entire full-scale range. A brightened trace portion identifies the position and the duration of magnified displays while in the locate mode.

Six signal heads, three pulse generator heads, and two trigger heads are available providing feedthrough 50Ω, and high impedance inputs with a wide variety of bandwidths (up to 14 GHz).

Full details from Tektronix (Aust) Pty. Ltd., 80 Waterloo Road, Nth Ryde. NSW.

MEASURING GRANULAR FLOW

A new electronic instrument, claimed to be the only one capable of continuously measuring the flow of granular materials in pneumatic conveying systems, without interfering with the flow, indicates when a mass flow rate exceeds or falls below a predetermined figure.

The instrument, developed by a British electronics firm and the National Research and Development Council, overcomes the problems associated with measuring the flow of solids in pneumatic conveyors.

Apart from its technical advantages, the instrument is claimed to be considerably less expensive than existing methods of measuring mass flow. These generally require the diversion of the solids flow from the pneumatic conveyor by a deflecting plate or similar device into an electro-mechanical weighing system to give a lbs/hr measurement.

By contrast, the new system called the Flowmeter P390 is attached to the sidewall of the pneumatic pipe conveyor so that there is no obstruction to the flow path. The instrument measures variations in capacitance noise to provide a direct meter reading of the mass flow. It has no moving parts, is unaffected by vibrations and requires virtually no maintenance.

Key to the system is the use of the turbulent nature of the solids flow to measure the density of the cloud of solid being blown along in a fixed length of the pneumatic conveyor. The turbulence causes random fluctuations in cloud density which result in corresponding variations in capacitance, similar to electrical noise. It is the magnitude of the variations which are measured.

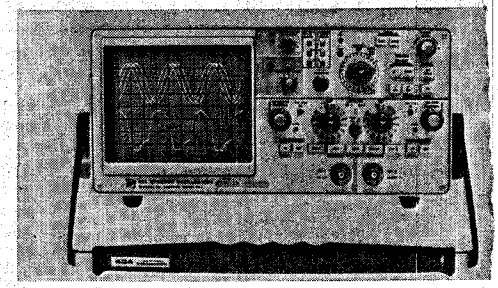
The instrument consists of a head unit and electrode, a power supply integrator unit and a meter. The small changes in capacitance due to the passage of particles past the electrode are converted to a varying voltage by a capacitance transducer, the ac output of which is rectified and smoothed. The smoothing time is adjustable between 10 seconds and 250 seconds to cover a wide range of flow conditions. The dc output signal in a range 0-10 mA can drive a number of remote-mounted *indicators and* recorders.

An advantage of the new capacitance transducer is that it is only sensitive to variations in capacitance due to the transit of particles and not by changes in standing capacitance due to the powder sticking to the electrode and other slow-changing effects – hence no zero adjustment is needed.

The instrument can be used with the wide range of pipe sizes encountered in industry and has been field-tested with materials ranging from finely powdered flour and cement to granules such as wheat and peas. Other applications being studied include gaseous suspensions and liquid slurries, industrial effluents and the detection explosion risks in aircraft refuelling.

Full details from Fielden Electronics Ltd., P.O. Box 6, Paston Road, Manchester M22 4TX, England.

PORTABLE STORAGE OSCILLOSCOPES



Storage has long been a desirable characteristic in portable oscilloscopes. Field uses for storage continue to expand as electronic equipment usage and costs place

stronger demands upon quick isolation and solution of problems. Many waveform measurement problems encountered in field servicing – or the laboratory – are easily solved. Some signals are single event or low repetition rate, aperiodic or random.

Bistable split-screen storage is a feature of the new 434 storage oscilloscope from Tektronix Aust. Pty. Ltd. It offers all of the advantages of a storage and conventional oscilloscope in one lightweight, small package with a large 8 x 10 cm screen.

Vertical height of the oscilloscope cabinet is only 5¾ inches. Depth, including the handle, is only 21 inches. Width is 13 inches. Weight is only 20¾ pounds, including panel cover and accessories. Rackmount versions are only 5¼ inches high.

Full details from Tektronix Aust. Pty. Ltd., 80 Waterloo Road, North Ryde, NSW 2113.

VARIABLE POWER SUPPLIES

Scientific Electronics Pty. Ltd. have introduced a new range of low cost high-performance variable power supplies, which they state are suitable for laboratory bench work, educational instituions, and for general purpose use.

The output voltage and current is fully adjustable to zero by ten turn controls which allow precision setting of voltage or current. The front panel meter can be switched to monitor output voltage or current.

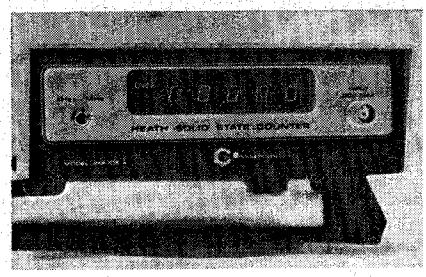
Constant voltage/current limit or constant voltage/constant current ensures short circuit proof operation and permits series and parallel connection of two or more supplies when greater voltage or current is desired.

The output is fully floating and can be operated as a positive or negative supply or floated up to ±300V from ground.

Both load and line regulation is claimed to be better than 0.01% and ripple and noise is stated to be less than 1mV p-p from dc to 20MHz. Units are available with outputs up to 50 volts and 2 amps.

Full details from Scientific Electronics Pty. Limited, 42 Barry Street, Bayswater, Vic. 3153.

LOW PRICE COUNTER



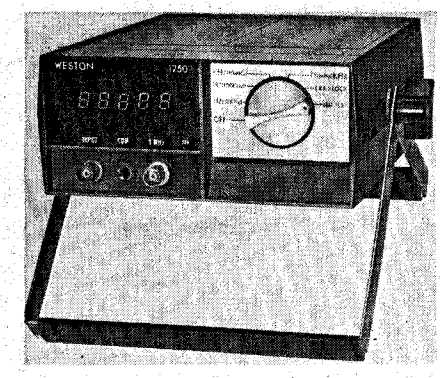
A new low priced frequency counter has been announced by Schlumberger-Heath.

Direct counting to over 80 MHz is provided with optional pre-scaling to 175 MHz. The self-adjusting input circuitry gives a trigger sensitivity of better than 100 mV at 50 MHz. Time base stabilities of up to one part per million per year are available with a choice of two standard crystals.

The SM-105A uses a five digit LED display with overranging to give eight-digit resolution. This form of semiconductor display is claimed to have a life expectancy in excess of 1,000,000 hours, and the total instrument reliability is further confirmed by a 200 hour high temperature burning of every counter before final checkout.

Full details from Schlumberger Instrumentation Australia Pty. Ltd., 112 High Street, Kew, Vic. 3101.

PORTABLE COUNTER



A new release from Schlumberger Instrumentation is the Weston Model 1250 Frequency Counter, a low cost portable instrument, designed for both general and special applications. The Model 1250 has a full range coverage of dc to 32 MHz and offers many features that the manufacturers claim are not found in larger bench units.

Special features of the Weston model 1250 frequency counter include solid-state LED readouts, storage circuitry for non-blinking readout, four ranges with automatic decimal positionings, a rugged thermo-plastic glass filled case, a convenient carrying handle

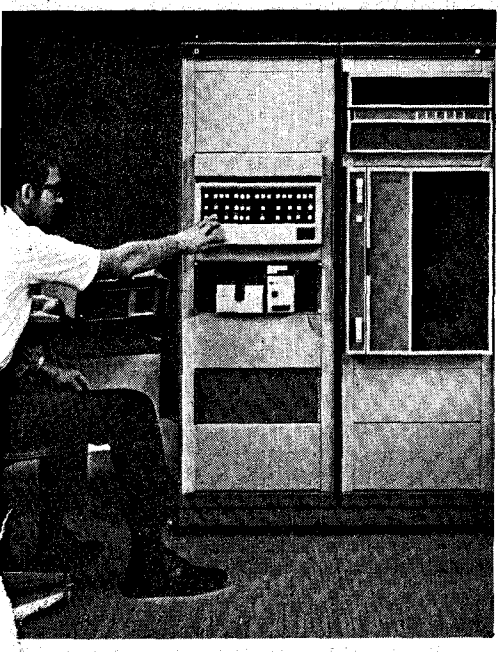
EQUIPMENT NEWS

which converts to a tilt stand, an optional leather carrying case, and panel mounting at no extra cost.

Specific design features include four gate times giving full scale readings of 32,000 kHz (32 MHz), 9999.9 Hz (10 kHz). The Model 1250 also has a switch position which allows use of an external time standard instead of the self-contained crystal. The external time base should be 1 MHz and is applied to the 1 millisecond gate (32,000 kHz range). Another feature available is a 1 MHz output frequency to troubleshoot circuits on a "closed loop" basis. For example, if a digital circuit is being tested, the clock for that circuit can be de-energized and the 1 MHz from the Model 1250 substituted to check the divide or gating circuits. The Model 1250 standard input is used while the 1 MHz signal is obtained from a separate output terminal and the 1250 can be set to the most convenient range for the circuit under test. External rechargeable battery operation is an additional option.

Further details from Schlumberger Instrumentation, (Australia) Pty. Ltd., P.O. Box 138, Kew, Vic. 3101.

NEW MINICOMPUTER



Hewlett-Packard has introduced a new low-cost computer, a high-packing density computer tape memory, and a compact computer disc memory.

The new units, the Model 2100A mini-computer, the Series 7970 tape memory and the Model 7900A disc memory, are said to provide the original equipment manufacturer and the end-user with a wide variety of low cost solutions to their computational needs. Modular construction of the units enables a user to tailor his data processing system to his immediate needs, yet increase it at a later date, if required.

The Model 2100A minicomputer is faster, more versatile and lower in cost than its predecessors. It is compatible with all existing Hewlett-Packard computers, peripheral equipment and software programmes. The computer is intended for use in a wide range of applications in business, industry, science, medicine and education.

Applications of the Model 2100A include use as a small industrial controller, as a multi-language stand-alone computer, as a part of a large time-sharing system or highly automated systems performing complex measuring, testing and computing tasks.

The Series 7970 computer tape memory is offered in two versions, the 7970B and the 7970E. The latter has phase-encoded electronics which allow high information packing densities (1600 characters per inch). Both versions are compatible with HP computers, and offer fast information transfer rates.

The Series 7970 is designed for use by original equipment manufacturers and HP computer users in system applications that require high information packing densities and data transfer rates. These applications include computer output microfilming, optical character recognition, off-line printing, computer batching and processing, data acquisition and conversion, intelligent terminals and communication and analysis systems.

The Model 7900A is a tough and compact computer disc drive memory with the fastest response time of any rack-mountable memory device now available. The random access, moving head, dual disc memory combines speed and large data storage capacity. It is designed for use in time-sharing, process control, data acquisition, automatic measurement, communications, computer aided instruction, data collection and batch data processing.

Full details from Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Vic. 3147.

INDUSTRIAL FM RECORDER

The system comprises four pairs of FM record and playback modules coupled to a Sony deck which has been converted to four track operation. Although the FM record and playback modules can be supplied separately for virtually any number of tracks and for any tape speed up to 60 inches per second, the composite system

The Melbourne telephone number appearing in the September issue of Electronics Today for Elmeasco Instruments P/L was incorrect. The correct number is 26-1552.

EQUIPMENT NEWS

offers facilities such as complete data protection, automatic selection of record speed and excellent signal-to-noise performance.

The FM modules feature the use of low-cost operational amplifier ICs and according to the manufacturer, this fact coupled with the use of a commercially available high quality tape deck, enables the cost/performance ratio of the FM300 system to be better than any similar type of equipment available today.

ELECTRONICS TODAY will be publishing a full product review of the FM recorder in the near future.

Electrodata Associates Pty. Ltd. is a recently formed Australian company dedicated to the design and manufacture of analogue and digital magnetic recording equipment. Its founder, Dr. Stanley Baker, is a graduate from the University of New South Wales and was previously employed as chief engineer in the Tape Systems and Recording Head Company of the Gresham Lion Group, London.

Future developments of Electrodata Associates Pty. Ltd. include two channel multiplex magnetic recording modules, calibration modules, battery operated FM recording modules and digital event recorders.

Full details from Electrodata Associates, 8 Barry Ave., Mortdale, NSW 2223.

DIGITAL NANOVOLTMETER

A new digital nanovoltmeter from Keithley features sensitivity to 10 nanovolts, 4½ digit display, automatic ranging, remote programming, isolated input, isolated output and an optional BCD digital output (also isolated).

The instrument, designated the Model 180 simplifies measurements that previously required a complex set-up of a potentiometer, standard cell, working source and null detector. The Model 180 can be connected directly to the unknown potential and resolution of up to five places can be obtained – with sensitivities claimed to be as low as 10 nanovolts per digit.

Furthermore, these measurements can be automated by using the unit's optional digital output.

An input impedance of over 100 megohms assures that the unit will not cause loading errors. The isolated input (isolated from chassis *and* the output) can be connected into a circuit without worry about grounding arrangements.

Display rate of the digital nanovoltmeter is adjustable from 2½ readings per second to one every five seconds. Settling time to rated accuracy is less than three seconds on all ranges except the most sensitive.

Full details from Warburton Franki, Box 182, Chatswood, NSW 2067.

EXECUTIVE COMMAND POST

The Plessey Communication Systems EDAS master station on the busy executive's desk gives him fingertip access to any staff member through his organisation's existing internal automatic telephone system (PAX).

This instrument, which is now available with a rosewood finish in addition to the standard teak finish, can be used on most private automatic exchanges instead of a conventional handset. It has the additional advantage of being a loudspeaking unit through which up to 18 extensions can be called by touching a name key.

Other extensions can be called rapidly by touch dialling on a keyboard and there are also facilities for priority or secretarial call.

Although a handset is provided for private conversations when desired, normal operation is 'hands-free' permitting conversations to be carried on at distances of several feet.

Full details from Plessey Communication Systems Pty. Limited, 87-105 Racecourse Road, North Melbourne, Vic. 3051.

ELMEASCO IN MELBOURNE

Elmeasco Instruments Pty. Ltd. have now opened an office and fully equipped Service Department at 33 Queens Road, Melbourne.

LOW-COST VACUUM TAPE DRIVES

A new low cost vacuum tape drive and tape cartridge recently developed by Digital Information Devices Inc., U.S.A., is now available in Australia from DC Datagraphix, a division of DC Industries Pty. Limited.

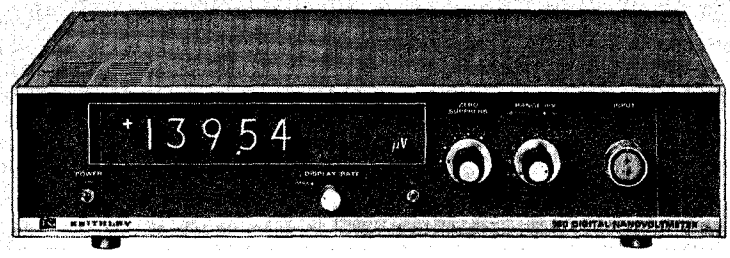
It combines the gentle tape handling of vacuum drive with the tape protection offered by a cartridge. The tape can never unwind accidentally because friction locks the reels into position in the tape cartridge. Once the cartridge is inserted into the vacuum tape drive system, the vacuum unlocks the reels so they can rotate freely.

Vacuum columns provide uniform tape tension. No pinch rollers are used, and the oxide side of the tape touches only the read/write head mechanism.

Vacuum is also used to control tape loading and unloading, tape positioning on the read/write head, tape guidance, tape advance and braking, plus tape buffering.

The tape used is the IBM standard 8½ in. and 1,200 ft. long, with a data density of 800 b.p.i. for nine-track and 556 or 800 b.p.i. for seven-track. The tape velocity is 18¾ i.p.s. with optional velocities of 37.5 i.p.s. and other speeds down to a minimum 3 i.p.s.

Full details from DC Datagraphix, 32 Smith Street, Collingwood, Vic. 3066.



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VHF Converters, Aircraft Band 108 Mhz-136 Mhz. Just place alongside your Broadcast Radio and set dial in a clear spot between 600 Khz and 1000 Khz, then do tuning on converter dial. No connecting wires are needed. Converter operates from 9 volt transistor battery. Price $14.65. P/P 45 cents.

POWER SUPPLIES, 35 volt, 5 amp, C Core Transformer and Filter Choke 5-10,000 uF 50 volt electrolytics Transistor Regulator voltage adjustable. Size 21" x 7½" x 7½". Weight approx. 25 lbs. Price $48.50. Freight forward.

POWER SUPPLIES, 12 volt, 5 amp, same specifications as 35 volt model. Weight approx. 18 lbs. Price $30.00. Freight forward.

SPECIAL. ERIE 1 watt 5% High Stab. Resistors and 2 watt 1% and 2% Mixed 1 and 2 watt, $1.50 per 100. P/P 40 cents.

TRANSFORMERS. 230 volt 50 cycle primary, 2 secondary windings, 70 volt, 20 amp each. Weight approx. 45 lbs. Price $25.00. Freight forward.

SPECIAL. HIGH IMPEDANCE HEADPHONES, 2600 ohms. Hurry, limited number only at this price, just $2.50. P/P 50 cents.

VALVES—6J6, 30 cents ea. ATS 25-807, 50 cents ea. 6J7, 60 cents ea. 6SL7GT, 60 cents ea.

SPECIAL ELECTROLYTICS. 75 uF 10 volt working, upright printed circuit type. 10 cents ea. P/P 6 cents.

CAPACITORS. .33 uF 400 volt DC working, printed circuit type. 10 cents each. P/P 6 cents.

MINIATURE RELAYS. 4 sets changeovers, 115 volt coils. 75 cents ea. P/P 40 cents. Limited number only, so hurry.

3,000 TYPE RELAYS. No specific coil resistance supplied. 50 cents ea. P/P 30 cents.

PHONE JACKS, 3.5 and 1.5 mm. 10 cents each. P/P 6 cents.

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SILICON DIODES. 100 P.I.V.-145 amps. $4.50 ea. P/P 40 cents.

CAPACITORS. Mixed values Mica and Ceramic. Poly bags, $2 per 100. P/P 30 cents.

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	Sensitivity DC	Sensitivity AC	PRICE
C-1000	1,000 o/v	1,000 o/v	$6.75
200H	20,000 o/v	10,000 o/v	$11.95
CT500/P	20,000 o/v	10,000 o/v	$17.75
AS100D/P	100,000 o/v	10,000 o/v	$34.50

Add 60 cents for pack/post.

COMPUTER MODULES. Contain 2.12AU7 and 1% Resistors. 40 cents ea. P/P 20 cents.

DENSHI CONSTRUCTION KITS, no soldering required. There are 16 Projects, including Transistor Radio, Morse Code Oscillator, Continuity Tester, Signal Injector, Transistor Wireless Microphone, Transistor Reflex Radio and numerous others. These kits are priced at only $11.50. P/P 80 cents.

ELECO ELECTRONIC KIT No. 9. 20 Projects, no soldering or tools required. This kit includes a Solar Cell. Projects include Transistor Radio, Transformer coupled with 2 Transistor Radio, Shortwave Radio, 2 Transistor Intercom, 2 Transistor Audio AMP, Signal Tracer, Wireless Microphone, Audio Oscillator, Microphone included in kit. SPECIAL PRICE only $16.50. P/P $1.00.

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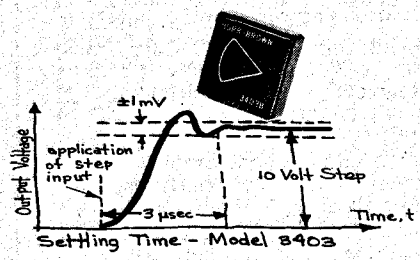
COMPONENT NEWS

FAST SETTLING OP AMP



Fast settling op amp performance is now available at very low prices with the introduction of Burr-Brown's new 3403 series.

These amplifiers settle in 3 microseconds to final value, ±0.01%. Two versions are available, differing only in voltage drift specifications. Model 3403A is ±50µV/°C, max, and model 3403B is ±20µV/°C, max. All other specifications are the same for both units.

The 3403 amplifiers have differential FET inputs and will settle equally fast in inverting or noninverting circuits. Principle applications are expected to be in A/D and D/A converters, sample/hold circuits, fast waveform generators, pulse amplifiers and high speed current amplifiers.

Full details from Kenelec Systems Pty. Ltd. 142 Highbury Road, Burwood, Vic. 3125.

EASIER PRINTED CIRCUITS

A new etch resist marking pen – designated 'Dalo 33 PC' – has made it possible for professionals and amateurs alike, to make their own printed circuit boards using standard copper clad laminate.

The required circuit may be drawn freehand on laminate. The ink from the Dalo 33 PC is an etch resist with complete immunity to attack from ferric chloride and other etchant solutions. It is claimed to adhere perfectly to copper. Drying time is 15 minutes, after which the board can be immersed in the etchant solution. After etching, resist can be removed by LONCO Sonic Solve 113.

After hole drilling, the circuit is ready for assembly of components.

The same pen will write easily and clearly on glass, metals, ceramics and plastics. Other inks are available for marking Mylar Computer Tapes, glass, metals, fabrics and leather.

Full details from Royston Electronics Pty. Limited, 22 Firth Street, Doncaster, Vic. 3108.

DC CURRENT TRANSFORMER

A dc current transformer, designed specifically for use in dc motor speed control circuits employing thyristors, is being manufactured by a British firm.

The transformer is available in two models to measure currents up to 100 amps and 500 amps. It is also said to provide an electrically isolated output voltage proportional to the ampere turns linking the centre of the unit.

Due to the fast speed of response of the unit, the voltage waveform is an accurate reproduction of the current waveform, particularly in the case of thyristor controllers for dc motors where the armature current is smoothed to some extent by the armature inductance-resistance time constant.

Because waveform as well as average dc level is reproduced, the transformer output may also be used to measure peak or root mean square values of armature current. Conventional current limiting circuits fed with signals from resistors in the motor armature are immediately able to utilise the signal from the transformer.

Negligible loss is said to be introduced in the load circuit by the primary winding of the transformer and calibration is largely independent of input waveform.

Full details from Reid and Sigrist Limited, Golf Course Lane, Hinckley Road, Leicester, England.

PLESSEY COMPONENTS GUIDE

A recently issued product data sheet (PD2068) gives details of Plessey Components Group products and services available from the Professional Components Department of Plessey Ducon Pty. Limited.

A complete alphabetical list of products is accompanied by descriptions of the activities of the various divisions of Plessey Components Group and the products for which they are responsible.

Similar information is given concerning licensee and associated companies.

Copies available from Plessey Ducon Pty. Limited, Professional Components Department, P.O. Box 2, Villawood, N.S.W. 2163.

MINIATURE POLARISED RELAY

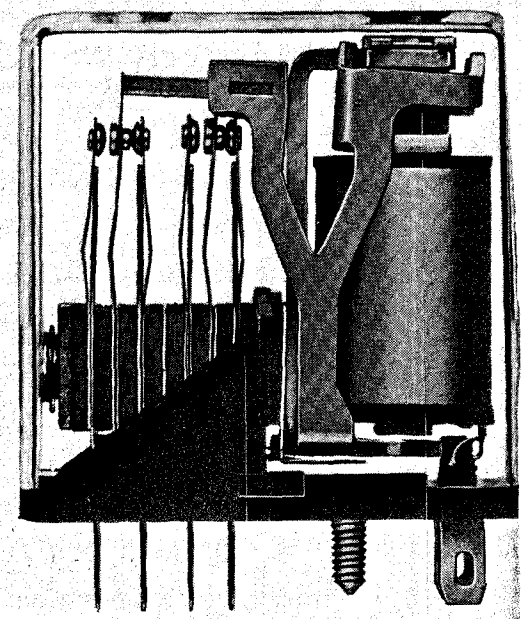
A bi-stable miniature polarised relay has been added to the well-known range of Varley VP plug-in relays.

The new design incorporates a high-grade permanent magnet that will retain maximum effective flux under full working load over the mechanical life of the relay. This gives a bi-stable switching action that will be invaluable in applications such as power failure fail-safe protection devices, and in giving sequence protection to such systems as ticket-issuing machines.

An interesting secondary benefit, is that fault tracing is simplified, as all bi-stable relays maintain their condition, whether operated or released, at the time the fault occurred.

Single-coil types can be supplied, or dual-coil (balanced resistance) types, all catering for voltages from six to 47 as standard.

Full details from Associated Controls Pty. Ltd., 14 Enterprise Ave., Padstow, N.S.W.



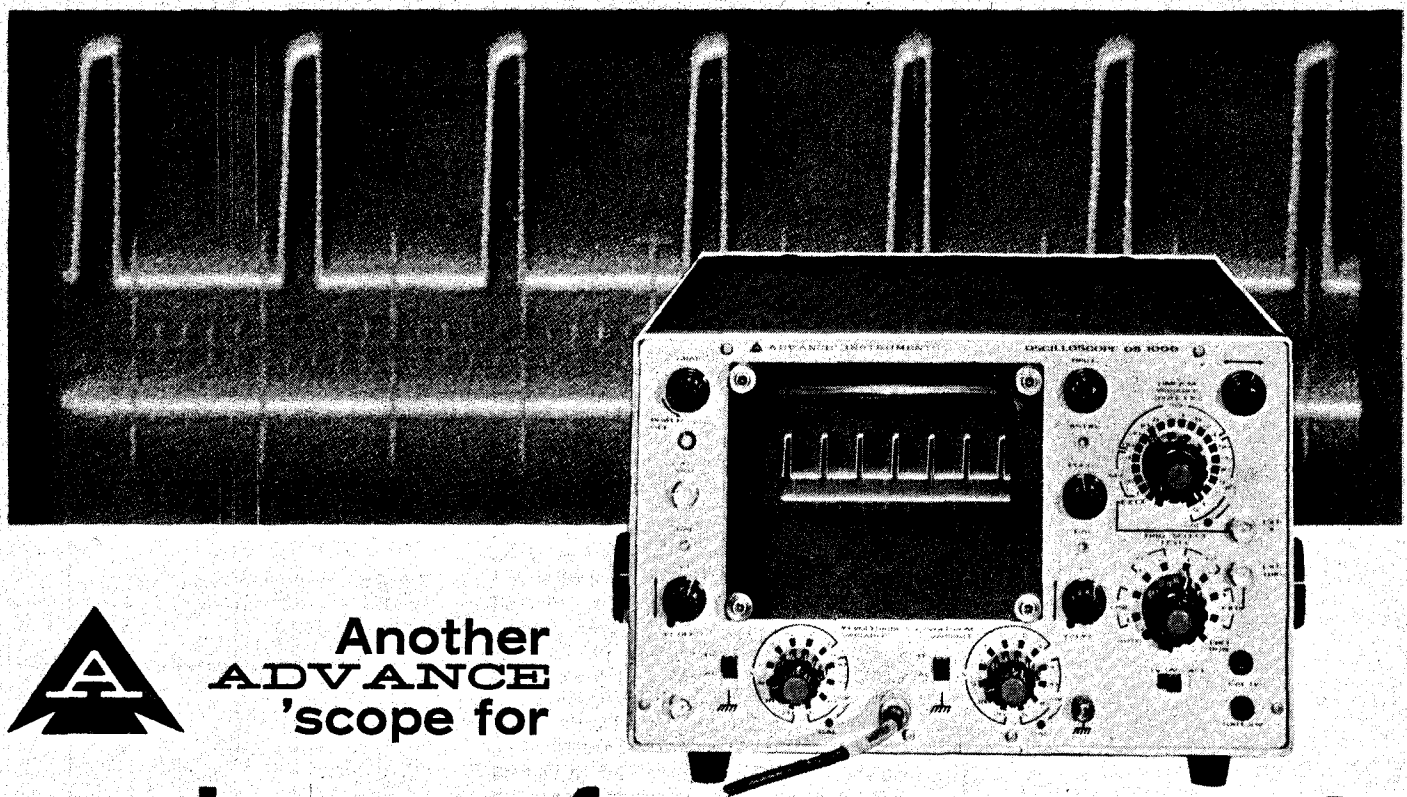
ENCAPSULATED REED RELAYS

Plessey Ducon Professional Components Department has released a new product data sheet (PD2069) dealing with its Type CRG, CRH and CRJ encapsulated reed relays.

These feature up to three-make action controlled by a common coil, pin centres designed for printed circuit mounting, DMC/Epoxy encapsulation, coil voltages ranging from 4.8 to 24V and standard contacts made of hard gold or tungsten.

The data sheet gives mechanical and electrical specifications of these relays as well as coil data, details of contact rating and life, and mounting dimensions.

Copies available from Plessey Ducon Pty. Limited, Professional Components Department, P.O. Box 2, Villawood, N.S.W. 2163.



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OS1000 oscilloscope
15MHz, 7" high

Here is a small size, lightweight 5mV/cm dual trace oscilloscope offering wide time base ranges and comprehensive trigger control combined with broad bandwidth and calibrated deflection factor. Solid state circuitry makes the OS1000 ideal for servicing or laboratory use.

DISPLAY:
10cm x 6cm rectangular tube with 4Kv overall E.H.T.P.31 (standard) or P7 (long persistence) phosphors available. With dark grey filter as standard. Brilliance, Focus and Graticule illumination by normal controls.

EXTERNAL Z MOD:
AC coupled rear panel socket. 1vpk.pk for visible modulation, 60V for blanking. Input impedance 1MΩ.

DISPLAY MODES:
SINGLE TRACE: Y1 or Y2.
DUAL TRACE: Alternate sweep or chopped mode (250KHz) automatically selected by time base setting:
Alternate sweep—0.5μS/cm to 0.5mS/cm, chopped mode—1mS/cm to 1 sec/cm.
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Y DEFLECTION:
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Sensitivity—5mV/cm to 20V/cm ± 3%.
BANDWIDTH: DC to 15MHz.
INPUT Z: 1MΩ/30pf.
INPUT COUPLING: AC/DC/Ground.

X DEFLECTION:
TIME BASE: Ranges 1 sec/cm to 0.5μS/cm with X10 Expansion ± 5%.
TRIGGER MODES: (i) Internal Y1 + or − (ii) Internal Y2 + or −. (iii) External + or −. (iv) Line + or −.
LEVEL CONTROL: (i) Manual or (ii) Auto with automatic free run in absence of signal.
EXT. TRIG.: Input Z. 100kΩ 15pf.
EXTERNAL X: Via external X input, sensitivity 1V/cm. Input resistance 100kΩ, bandwidth DC to 2MHz.

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(H) (W) (L)

Probe Kit

An accessory probe kit is available for use with the entire range of Advance oscilloscopes. This provides for a standard compensated test lead which may be terminated at one end with BNC or UHF type connectors and at the probe end may be fitted with probe bodies of x1 and x10 ratio. Spring-loaded hook, needle, 4mm plug and alligator tips may be fitted to the probe, which also has provision for a grounding lead connection adjacent to the probe tip. All the parts are supplied in a plastic wallet suitably compartmented.

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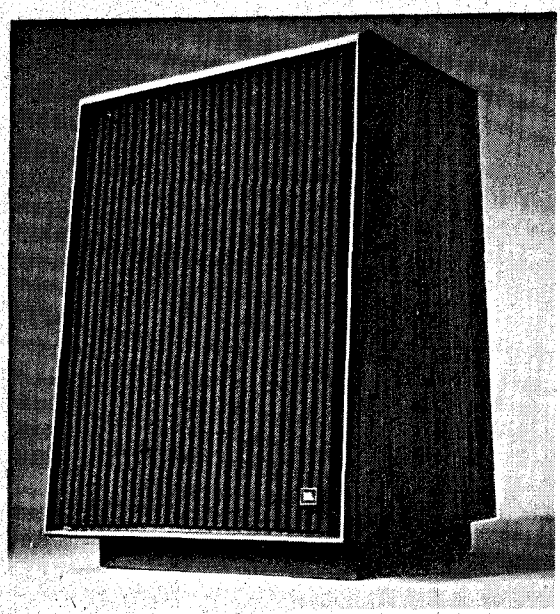
AUDIO NEWS



NEW BIG SPEAKER

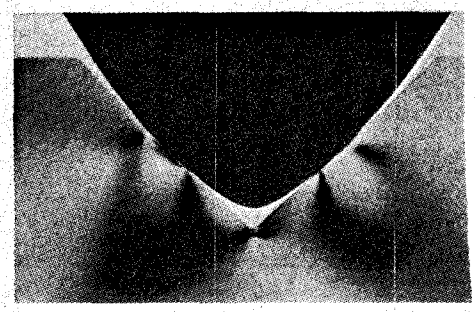
A new speaker system from JBL is the consumer version of the large JBL Professional Studio Monitor. Its introduction follows closely that of the highly successful L100 Century bookshelf size system which was also derived from a commercial product, the compact monitor.

The L200 Studio 2 is a floor standing model with a deep fluted vertical grille pattern called Crenelex. The material is described as being acoustically more transparent than cloth. The cabinet is finished in oiled walnut and the face of the cabinet has a sloping front aiding sound dispersion and creating an unusual geometric design.

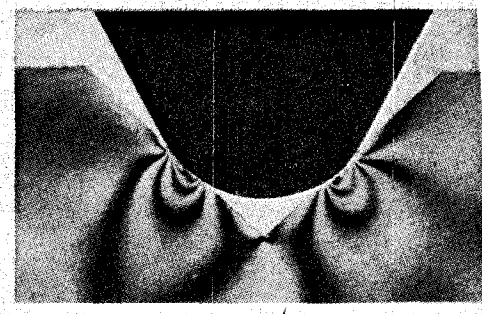
The internal components are a 15-inch low frequency transducer, a horn loaded high frequency driver with an acoustic lens and a matched frequency dividing network.

The L200 speaker has a power handling capability of 100 Watts, yet due to its high efficiency can reproduce clean sound with as little as 10 Watts input.

STYLISH STYLUS



Tension on disc groove caused by JVC tip (at 2 gm).



Tension on disc groove caused by elliptical stylus (at 2gm).

A new stylus developed by the Japanese Victor Company is claimed to maintain a groove contact area that is four times that obtained with elliptical stylii.

The increased contact area reduces stylii pressure on the walls of the grooves, thus reducing record wear and extending the life of the stylii.

DOLBY APPOINTS LOCAL AGENT

Britain's Dolby Laboratories Inc., has appointed Magna-Techtronics (Aust) Pty. Ltd., as their representative in Australia.

The exclusive range of products include the well-known Dolby noise reduction systems. These systems are used extensively around the world in broadcasting and recording studios to increase the signal to noise ratio performance of tape recorders during recording and playback.

The Dolby system is of particular advantage when multiple track recorders are used as it allows considerable noise reduction during recording and mixdown. Systems are also available for tape duplicators.

In broadcasting, Dolby can be used to improve the performance of tape systems, particularly audio and video tape recorders. Furthermore the Dolby system can be used for noise reduction on land-lines.

A further Dolby system designed to improve the signal to noise ratio of FM broadcasting is currently being evaluated in the USA. The 10 dB of noise reduction that is normally achieved, increaases the good-signal coverage of a broadcasting station, by an amount that, according to Dolby, could only be otherwise achieved by increasing transmitter power several times.

This new type TRM-1200 stereo amplifier from Peak features integrated circuit construction. It is handled in Australia by H. Rowe and Co. Ltd.

DOLBY LICENCE

Dolby Laboratories has licensed some more companies to produce Dolby circuits.

In addition to Nakamachi and Hitachi, three more Japanese companies will shortly commence manufacturer.

CLEANER TAPES

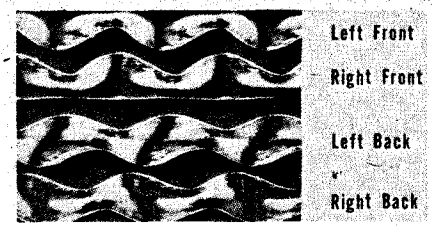
Cassette tape recorders can be cleaned and degaussed in a matter of minutes by using a neat little gadget from Ampex.

Instead of magnetic tape, this standard sized 'cassette' contains a length of cleaning tape wrapped around a (ceramic) magnetic roller.

The manufacturers say that the magnetic field has been so calculated that the device has a similar performance to professional head-degaussing devices.

AUDIO NEWS

FOUR-CHANNEL DISC



Modulation in groove of new four-channel disc.

A four-channel record that is still compatible with two-channel systems has been developed by Columbia Records in the US and will be marketed jointly by Columbia and Japan's Sony Corporation.

The new technique uses a double helical principle of modulation that encodes four-channel data in a two-channel groove that is basically similar in shape to conventional two-channel systems.

A special Sony decoder reproduces four-channel information, but without the decoder the record may still be played on a two-channel player when it will reproduce two-channel sound.

The four-channel records are made by passing all four channels through an encoder, which records the two front channels precisely in the same way as with a standard two-channel record. But in addition the encoder produces two additional circular modulations that correspond to the rear channels.

As the record rotates and the groove advances, a clockwise helix is produced for the left rear channel, and an anti-clockwise helix for the right rear channel. These two helices carry the rear channel information. The modes of modulation are shown in the photo-micrographs.

CBS state that the new four-channel records will be marketed at prices only a little above existing two-channel stereo records.

Sony Decoder TA-2241

Sony Decoder 2245

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RECORDINGS... CLASSICAL

REVIEWERS: John Clare, Christopher Wagstaff.

CYORGY LIGETI — Requiem, Lontano For Full Orchestra, Continuum For Harpsichord, Symphony Orchestra of the Hessian Radio, Liliana Poli, soprano; Barbro Ericson, Mezzo soprano; Choruses of the Bavarian Radio; Michael Gielen, conductor. Symphony Orchestra of the Southwest German Radio; Ernest Bour conductor; Antoinette Vischer, harpsichord; Heliodor 'Wergo' 2549 011, stereo.

If you have not heard Ligeti's Requiem, you have at the very least a rather impressive physical experience awaiting you. Whether or not you find it a 'spiritual' experience is another matter.

At first hearing it may seem that Ligeti has created something like an abstraction of all large scale religious works, bypassing conventional musical considerations to render the general idea in sheer sound. The first part often seems to me like a more successful application in sonic terms of the idea behind the large Piper stained glass window in the new Coventry Cathedral. The eye is supposed to move up from the deep indigo and Prussian blue glass at the bottom of the window, through purple, mauve, cerise, red, orange, yellow, amber, until sight is lost in a great effulgence; pure light, an apotheosis of light.

In the Requiem we begin with deeply intoning voices and move up chromatically through an amazing complex of sound. The task of organising the proceedings must have been a prodiguous one, more like a feat of architecture or engineering. The upward development is performed by a mixed chorus of five voice ranges, each subdivided into four parts. The five groups are set off against each other, yet each is contrapuntally self-contained. Nothing new in this, of course. Montiverdi will already have sprung to the alert reader's mind. However, according to the highly detailed and sometimes rather obfuscatory cover notes: " . . . the chromatic entanglements of the individual part writing duly abolish the polyphonic effect while it is emerging." Sonorous orchestral curtains heighten the effect of near stasis.

By the time the Lux Perpetua is reached, it might be said that everything is happening. The truly blinding effect seems to be enhanced by the deliberate use of harmonic beating. Many readers with a general interest in sound will know that two notes whose frequencies do not have common multiples will produce a regular throbbing or 'beating' where the wavelengths go out of phase, as it were.

Amid the massed voices singing in the upper register this phenomen creates a sort of subsidiary ringing and shrilling varying in intensity as the different voices and groups of voices slowly entwine and move into different relationships with each other.

Beneath all this, incidentally, seemingly miles beneath it, is an almost subliminal muttering and moaning, which reminds me of Tennyson's famous lines "The murmuring of innumerable bees in immemorial elms" or of my old friend William Faulkner who in 'The Sound And The Fury' likened bees in an orchard to a rising wind.

The second part uses blocks of apparently static sound broken by sudden dramatic exclamation, often incredibly high and piercing, by the soprano and mezzo soprano who are sometimes joined in unison by a very powerful trumpet. The top notes are quite intentionally, screamed rather than sung, albeit with phenomenal accuracy.

The Lontano uses a modification of many of the principles of the Requiem. I suggest that the interested reader will find it worth his while to wade through the notes by Harold Kaufmann on the Requiem and those by the composer on the Lontano. These notes, along with the virtuoso performances by both orchestras and choirs make this a valuable recording.

The actual quality of the pressing here is much better than I have come to expect from this label of late. The sound is a little shallow nevertheless. The balancing of the sound, however, the retention and placing in perspective of all the bewildering detail seems to me quite miraculous. – J. C.

A SCHUBERT RECITAL — Jean-Rodolphe Kars, Piano DECCA SXL 6502.

The first side of this disc is devoted to the 'Wanderer' Fantasia – a work of fantastic proportions ending with a gigantic fugue, while side two is devoted to two impromptus (D. 946 No. 1 and 2) which were written in the last year of Schubert's life. Surprisingly the best performed work is the 'Wanderer' Fantasia.

The impromptu, though not nearly as technically difficult, are played rather as if they were Beethoven, not Schubert. Themes are not always well brought out – a pity, because, after all, it is these melodies which give each work Schubert's signature. Also we find a little too much concentration on the inner parts. Kar's rubato is always appropriate and very effective but one might wish for a little more. Pauses (these apply also to the Fantasia) are sometimes a little too brief while the break before the commencement of the second theme in the Andaline (first Impromptu) is much too long. (Phrase breaks, by the way, could also be a little more distinct). Nonetheless the works do have many gloriously beautiful moments (listen to the chorale-like Andante of the first impromptu) and it would be quite wrong to say this is a bad performance.

The 'Wanderer' Fantasia is played masterfully with all the drama a man versus the elements (Einstein). Mood changes (especially in the Scherzo) are carefully thought out and delivered confidently (as are the transitions from movement to movement). Again, some of the left hand semiquaver configurations (in the Presto) are a little too strong against the melody.

The fugue is a supreme test for any pianist and Kars passed with honours. There is a tremendous verve and a very commendable technical brilliance, though in places one notices a wavering of strength (physical). Certainly Richter's performance (H.M.V.) is more spectacular but this is not too far behind and at 24 Kars has a brilliant future ahead of him.

Sound is very clear. Bass is perhaps a little too strong. – C.M.W.

BARTOK — Concerti for Piano, Nos 1, 2, 3. Rhapsody for Piano and Orchestra Opus One. Gabor Gabos, piano. Gyorgy Lehel conducting the Symphony Orchestra of the Hungarian Radio and Television. Stereo. Qualiton LPX 1250.

Part of the Qualiton series of the complete works of Bartok, these recordings have been available previously, but are being imported once more by Vanguard Electronics. According to the attendant literature "most of the Hungarian performers of the complete Bartok edition were pupils of the master, and were thus able to acquire the correct style for performing Bartok's works".

Consulting these performances in that light, we find cause to dispute the claim made by the accompanying booklet that Bartok's romantic influences ended more or less with the Rhapsody for Piano and Orchestra.

In a recent review in ELECTRONICS TODAY of a performance of the Concerto No. 2 by Stephen Bishop (Phillips), I took the usual line in speaking about this as 'pure music'. The somewhat slower reading under review emphasises the romantic elements present in the second and last movements.

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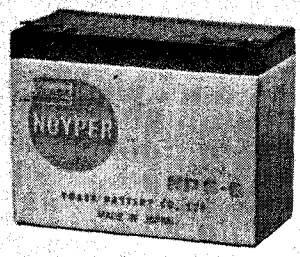

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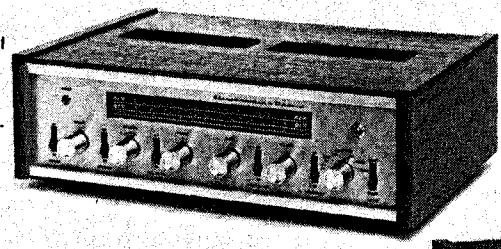

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CLASSIC RADIO

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CLASSICAL

In fact, certain piano passages have a strong feeling of Rachmaninof,' and in the Concerto No. 3 we find an almost totally romantic work, with some positively Beethovian overtones.

Still, the second concerto can hardly be called romantic, overall. The romantic elements seem almost incidental to Bartok's endeavour to make his piano works more accessible, following the scandalised reaction in his first piano concerto.

The predominant quality of this delightful music is still, to this day, freshness; an unsentimental vivacity which begins with the introductory motive on trumpets, stately and sprightly at the same time, an apparent paraphrase of Stravinsky from 'The Firebird', and which never gives way to overheating through the brilliant and exciting development of the two themes (also Stravinsky-ish) introduced subsequently by the piano.

One is invited in the second movement adagio to contemplate but not wallow in deeper and more mysterious regions, and there are some of those glorious moments of which Bartok is capable, when the lower strings seem to rise out of the earth, and limpid strands of sound draw everything in toward silence. There is a Scherzo within the adagio. Then the terrific momentum of the final movement.

Gabos' playing is not so percussive as Bishop's is in the first movement, not so obviously brilliant or rhythmically emphatic. In fact, it is detached by comparison. Perhaps it is the lesser emphasis on rhythm which made his playing seem paradoxically more 'romantic' in slower passages.

In the return to Adagio in the second movement there is a striking illustration of the difference in the two approaches. A long trill is held very quietly, actually a series of trills with short linking phrases. Bishop uses the linking phrase as a sort of a thrumming emphasis to the dynamic tension of the long held trill. Gabos treats it as a decorative waver in the long silvery line he is sustaining.

And the dreaded first concerto itself? Well, I believe that it would still be difficult for anyone unfamiliar with the work to assimilate it immediately in terms of theme, development, recapitulation, etc., but at the same time I don't think many people today could find it actively unpleasant, even at first hearing.

For me it has all the energy and multi-linear fascination of a Fairweather painting, though with its racing lines of contrapuntal development, it is not to be seen as a mosaic. If it is difficult to attach any romantic associations to this work it is not without a special dynamic drama.

It should now be clear that dissonance does not necessarily denote harshness and violence. Here dissonance is often used to create a cool, chiming limpidity, and to increase the momentum of the piano line in chords stabbed ahead of the beat.

Important drum rolls in the first movement are much too muffled on this recording and elsewhere the sound, never brilliant, becomes quite dull.

The Rhapsody and the Concerto No. 3 best show Bartok's more conventional melodic gifts, and his calmer and more sonorous orchestral writing. I cannot profess total satisfaction with the rhapsody, certain passages of which make me slightly impatient: A feeling that, yes, this has all been done. The third concerto, however is justly regarded as one of Bartok's greatest works. Restrained and infinitely expressive, restrained that is until the fiery finale, the work was dedicated to his wife and written at a time when Bartok knew he did not have much longer to live. The peaceful string introduction and chorals for piano in the second movement are among the loveliest things in music of this century.

Garbos' playing is again completely contained, one might say compact, and devoid of flamboyancy. I felt that more gusto could have been applied to the rhapsody, but admired his touch in the third concerto, in which there is also some very fine string playing, and finely pointed chirping fragments form the flute, muted trumpet and oboe in the second movement. The lower strings throughout lose much in the reproduction.

The quality of the recorded sound varies quite puzzlingly from movement to movement in this particular set. – J. C.

MOZART — Symphony No. 28, Symphony No. 29,Karl Bohm conducting the Berlin Philharmonic. DGG 139406, Stereo.

Karl Bohm, who can usually be relied upon to get a thing right, has excelled himself, in my humble opinion, in these two performances.

To the clarity and zest one expects from a first-rate performance of either of these two symphonies, written in Mozart's late teens, are added an unusual fullness of sound and beauty of orchestral tone. Much credit must go to the Berlin Philharmonic, but if they were not guided by a clear and determined realisation of the music, the fullness of sound could have been quite un-Mozartian. Note the extraordinarily plummy and homogenous string sound achieved usually in the second line of counterpoint. This is particularly evident in the second movement of the Symphony No. 28, where the second line, though full and round has a rather pleasing remoteness from the first, almost a hornlife quality. Straining my ears, I feel that this is achieved by having two violas play in unison.

All the spontanaeity of Mozart's invention is here realised, clothed as well with an unusual grandeur. All the parts sing, even at joyful speed, and just the right degree of poignancy is held in the tranquil beauty of the slow movements.

I do not feel inclined to make comparisons. If you are looking for excellent performances of this music, beautifully reproduced, you will not go far wrong with this recording. – J. C.

BEETHOVEN — Symphony No. 7 in A (Op. 92) Arturo Toscanini — New York Philharmonic R.C.A. Vistrola Vic. 1502.

This performance was recorded in Carnegie Hall in 1936 and, as might be expected, sound quality though miraculously improved, is well behind today's standards. Do not, however, let this influence your acquisition of the disc. After two or three playings the individualistic temperament of Toscanini becomes apparent and the performance is one difficult to forget.

There is tremendous drive and vitality throughout, and a feeling of firm control over the symphony's complex rhythms. The New York Philharmonic plays very well indeed (thank goodness, for their sakes). Entries are precise and intonation is generally very good (horns a little under pitch in the exposition of the first movement).

But how different is this performance to any other?

Well for a start, there is a more developed dramatic tension than what one associates with this work. The first movement is fiery enough but, my goodness, the last movement can only be described as electrifying. The speed and intense vigour with which it is delivered leaves one quite breathless (note the exciting brass entries). The second movement is slightly faster and the staccato is sharper than one is accustomed to hear – this preventing the movement ever approaching sentimentality. There is certainly a mood of serenity yet one is always prepared for an eruption. The highly spirited scherzo has its contrasts well and sensibly differentiated. Accents throughout are very clearly defined – the use of "double dotting" in the Trio of the Third movement for example is very effective in this regard.

What if there are a few flutters and what if the sound is rather muffled? Do we listen to a record for its sound or for quality of performance? At $2.55 one cannot really lose here. – C.M.W.

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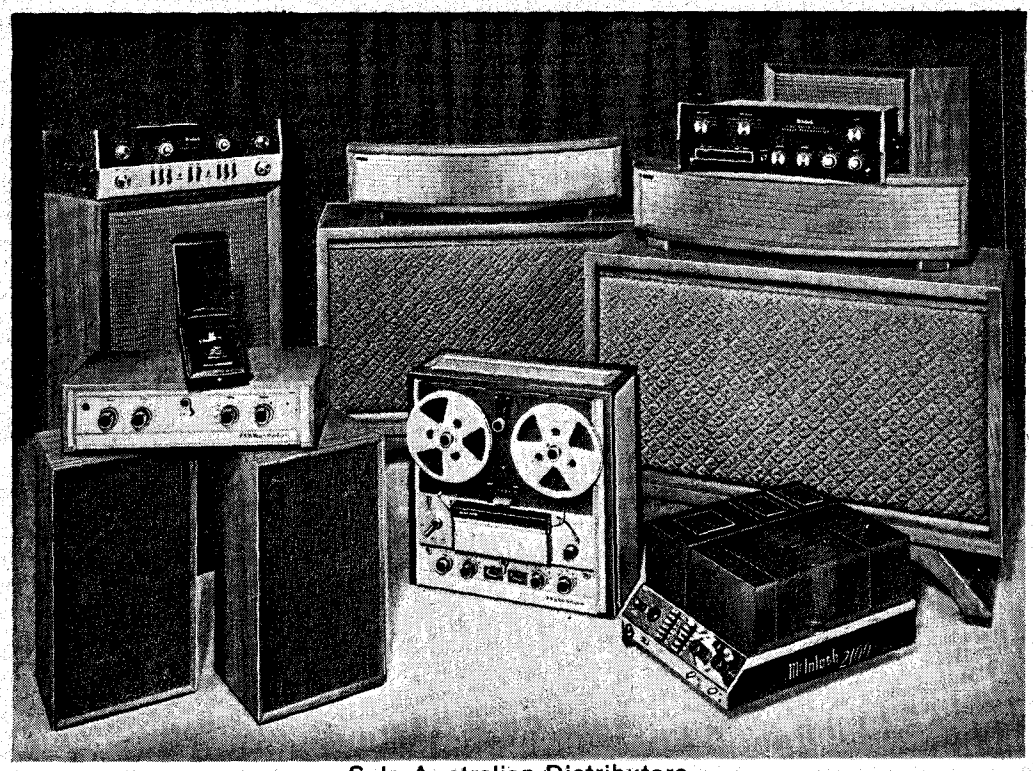

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RECORDINGS... JAZZ

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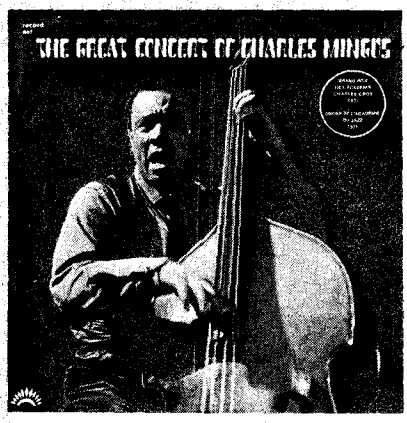

CHARLES MINGUS — The Great Concert Of Charles Mingus. America, Stereo AM003-4-5 (three record set) Good Bye Pork Pie Hat, Orange Was The Colour Of Her Dress, Parker Iana, Meditation On Integration, Fable Of Faubus, Sophisticated Lady. Charles Mingus, Eric Dolphy, Clifford Jordan, Jaki Byard, Dannie Richmond. Johnny Coles.

There is a lot of good jazz available on record at the moment, and this is some of the best of it. Recorded at the Theatre des Champs Elysees in 1964, it represents the first acceptance of Mingus by a French audience. Usually ahead of America in accepting American jazzmen, they had been rather cool to Mingus during his previous visit in 1959.

I wish that this could have been a two and a half record set, because the first side, 'Goodbye Pork Pie Hat' is badly recorded and badly played. I have only heard it once, and I do not wish to hear it again. Trumpeter Coles is absent from the rest of the sessions, having been taken off for an operation (for what, exactly, is not divulged on the sleeve) soon after 'Pork Pie'. He's a good player, but here he sounds as though he is about to keel over at any moment.

The next side, 'Orange Was The Colour Of Her Dress', was recorded the next day, as were all the other tracks, when the band had recovered its cohesion. This is an extended blues form in three parts, including one brief up-tempo interlude. So relaxed and sensitive are all the musicians that they are able to play with great sensuality and passion without destroying the overall feeling of tranquility which pervades the whole performance. Jaki Byard begins with some beautiful blues piano, which gradually rolls out into more lyrical and impressionistic areas. He ends with some startling two handed chordal figures reminiscent of Art Tatum. Jordan's tenor is effective within a fairly conventional blues format, though in his tone he occasionally tries to imitate Dolphy whose solo is to come.

Dolphy, the late genius of contemporary jazz, begins his solo with a typical outpouring of ideas. With his odd springy, buoyant, wiry sound he sounds on alto as though he is playing a higher version of his bass clarinet. Ideas just run and flower, seemingly out from every key as well as the bell of the instrument. He soon subsides back into the calm pace of the preceding solos and then takes off on a few startling forays into the upper register, getting an indescribably fruity, sharp sound, not unlike that of Johnny Dodds on clarinet. Mingus takes it out with one of his finest bass solos, clambering rapidly over the instrument, grabbing off fine round solid notes, sliding down long passionate singing ones.

There are so many enormously good bass players around today that it would be impossible for anyone who did not play bass to decide who plays it best, from both a technical and expressive point of view, but Mingus is certainly a giant, and he seems to me to be the man who has done the most for the bass as an expressive instrument.

The version here of 'Meditation' is not the best one I've heard. Dolphy is a bit below par on alto, and although the up tempo sections often swing like mad, they also get a little too loose for my tastes. The final dialogue between Dolphy's flute, Byard's piano and Mingus' bowed bass makes up for everything.

This kind of music beggars description. I tried to say something about it in our recent review of a similar performance by a larger Mingus unit (Mingus at Monterey), and this is just as good.

Dolphy is in great form on 'Parker Iana'. At times he seems to be everywhere: On a high speed pogo stick, turning somersaults, pouring forth a veritable blizzard of sound. Perhaps I am mistaken, but I sometimes seem to sense a rare fury in Dolphy's playing, as though he is saying: 'How many times do I have to blow the house down before I am acknowledged?' His technique is possibly the most remarkable of all alto players, and he has the ideas to match.

Moments of indecision and ragged passages are outweighed by the wealth of memorable music on these recordings. The sound is more than adequate for a live recording and the remastering for stereo does not seem to have done too much harm. The set is imported by Carinia Records. – J.C.

LOUIS ARMSTRONG — Louis Armstrong Plays W.C. Handy. CBS 62301, mono. St. Louis Blues, Yellow Dog Blues, Loveless Love, Aunt Hagar's Blues, Long Gone, The Memphis Blues, Beale Street Blues, Ole Miss, Chantez Les Bas, Hesitating Blues, Atlanta Blues. Trummy Young, Barney Bigard, Billy Kyle, Arvell Shaw, Barrett Deems, Velma Middleton.

Vanguard Electronics are importing several Armstrong recordings on French CBS. Weirdly enough, they've sent us for revue, a copy of one that's not being released locally, but can be obtained through them. Therefore, we should preface this review by saying that it will be a lot easier for you to get hold of 'Satch Plays Fats' which with this recording is one of the greatest of Louis' later period. On the other hand, if enough people show that they are interested, Vanguard will release this one as well, so I'd better say some nice things about it.

Really, there's very little that I can say, except that these performances of Mr. Handy's beautiful old tunes could not be bettered. Nobody ever invested the trumpet with more nobility than did Louis, and these are among his most powerful and moving performances. I played them for Kevin Wolfe, who does the odd classical review for us, and he said that they made his hair stand on end.

When I first heard them I began to cry. Enough said.

'Satch Plays Fats' is available in most big record stores. This one should be available soon, but your dealer can order you a copy from Vanguard. – J. C.

FLETCHER HENDERSON — The Dixie Stompers 1925-6 Swaggie Mono S1277 Spanish Shawl, Florida Stomp, Chinese Blues, Panama, I've Found A New Baby, Nervous Charlie Stomp, Jackass Blues, Tampeeko, Hi Diddle-diddle etc. Joe Smith, Rex Stewart, Coleman Hawkins, Buster Bailey, Charlie Green, Don Redman etc.

This recording is of enormous historical interest.

Firstly, it contains some of the earliest recorded work of Coleman Hawkins (the earliest was with Henderson in 1923), of Joe Smith and Buster Bailey – whose names will probably have a familiar ring even to those who are not particularly interested in this kind of music.

Secondly, and probably most interesting, it is a generally excellent showcast of the work of arrangers Henderson and Don Redman, who were both destined to exert considerable influence on subsequent musical trends. Redman never achieved the prominence of Henderson, but his influence probably reached further. Echoes of his band theme of the thirties, 'Chant Of The Weed' can be heard in Gil Evans' writing in the fifties and sixties. Redman was later to become musical director for Pearl Bailey. Henderson was most widely known for the arrangements he made for the bands of the Dorseys and of Benny Goodman.

It is no secret that I do not think very highly of the Goodman band, though I am quite willing to concede that they brought enjoyment to millions and helped create a market for jazz. Though these recordings sound superficially more old fashioned than the brilliant, precise show band style of Goodman's organisation, I find this stuff more interesting and more satisfying. There

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JAZZ

are pre-echoes here of the riffs and brass punctuations of the swing era – the conventional swing formula seems to me one of the emptiest in music – but the sections of these much smaller groups do not seem so rigidly demarked, and there are some elements of improvised 'dixieland' jazz particularly in the clarinet playing, what would seem to be an improvised descant over the arrangement in places, to add interest.

The rhythm is quite conventional for its time, which means that it sounds very old fashioned now, and this with a certain all pervading brightness of tone and cheerfulness of approach will make it difficult for most listeners to sit down to more than one side at a time.

The music is happy, it seeks to express nothing else. The solos are generally short, the tracks themselves are short, and they are almost without exception perfectly constructed, highly musical and rhythmic within the rhythmic limitations of the time.

The strength of Coleman Hawkins' line is already apparent, and it seems obvious that he had to expand into a wider ranging, romantic approach. Perhaps romantic is the wrong word. You will know what I mean.

Joe Smith's solos are neat and lyrical, and he produces a lovely, but never a ravishing or rhapsodic sound. I don't think that it is too far fetched to see a parallel between his work and that of some so-called cool modern trumpet players, such as Chet Baker, Don Fagerquist or Art Farmer.

Bailey's clarinet and Charlie Green's trombone are more in the looser, rougher New Orleans tradition.

These tracks were not recorded electrically, but with a couple of exceptions the sound is surprisingly good, though there is, of course, a certain shallowness which makes me wonder if we really hearing all the dimensions of this music as it was originally conceived.

As it comes to us, it makes up some of the happiest music on record. – J.C.

MILES DAVIS — A Tribute To Jack Johnson. CBS, stereo, SBP 233937. Right Off, Yesternow. Miles Davis, trumpet; Herbie Hancock, keyboard; John McLaughlin, guitar; Steve Grossman, soprano sax; Bill Cobham, drums; Michael Henderson, Fender bass.

If you saw the long programme devoted to Cassius Clay and Joe Frazier that one of the TV channels showed prior to the heavyweight championship, you will have heard some of this music. There was a scene where Cassius watched old films of his idol, Jack Johnson, and under it all you could hear the ominous bass riff and Miles' first savage solo from this recording.

I can assure you that this music catches the exact feeling of standing up at the bell, having scraped your feet in the resin and shed your robe, and beginning the peculiar slow-motion sprung dance, blood roaring in your ears, all dream-life and weirdly exhilarating, out to meet your adversary.

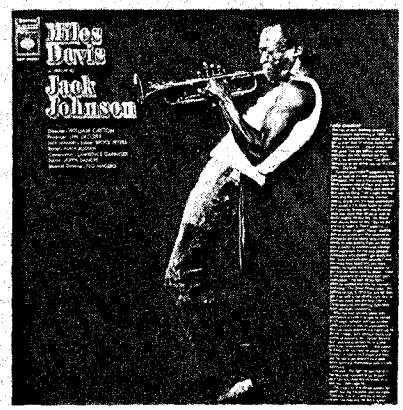
There we shall leave the fight game and have a look at the music. This should be the most easily accessible of all Miles Davis' recent albums, because it is the closest to conventional rock and roll. The opening of 'Right Off' even sounds for a moment like Chuck Berry's rhythm section. John McLaughlin's guitar phrases seem to be torn off and whipped away over his shoulder by the urgent momentum. Miles comes in and takes over with the biggest trumpet sound around today. As on the third side of the 'Filmore' double album, he just gets stronger and stronger as his solo progresses. He takes a brief rest and then comes back with some beautiful lyrical work before whipping everything up again. Steve Grossman takes over on soprano, and it is to his credit that little of the tension is lost. There follows a peaceful interlude with Miles playing muted into a loop echo delayer, that is to say he is playing over the echo of his previous phrase.

The other side 'Yesternow' is a little further out, but not so difficult for the newcomer to get into as 'Filmore'. Here a passage is taken intact from a previous album 'In a Silent Way' and most of the side has that peaceful feeling, despite the greater rhythmic complexity.

The side ends with an orchestrated section drenched with the Moorish feeling of Sketches of Spain, over which Brock Peters reads the words of Jack Johnson: "I'm Jack Johnson, heavyweight champion of the world. I'm black and they don't let me forget it. I'm black and I don't let them forget it."

I don't find as much in this album as I did, and continue to find in the previous double albums, but I wouldn't want to be without it. It should certainly have wider appeal.

The production, by Teo Macero, is brilliant. Hear it through earphones if you can. – J.C.



BRUCE GRAY'S ALL STARS — 'What's New' Swaggie, Stereo S1285.

Bruce Gray has been one of Australia's top clarinettists for more than a quarter of a century – which doesn't make him all that old.

He and trumpeter Bill Munro were the most gifted musicians in Adelaide's Southern Jazz Group, which was formed in the mid-forties and which was voted one of the best bands at the first Australian Jazz Convention in Melbourne in 1946. A transient drummer with the group in 1948 was Kym Bonython, who sent some of their records to an appreciative Gene Krupa. "I think they're good, very good," Krupa told Dick Hughes in London in 1953 and Hughes had the feeling he was kidding him not.

In 1950, the clarinettist formed his own group, Bruce Gray's All Stars and they've been functioning as such – not so regularly as we would like – ever since.

So What's New is the title of a new Swaggie release by Gray's All Stars, with Bill Munro still on trumpet, Gordon Coulson on trombone, Guy Piercy on electric bass, Norm Koch on banjo and Trevor Campbell.

It's quite a admirable record which Mike Williams of The Australian has called one of the best Australian jazz records ever made. Certainly it's one of the better.

I'm not happy all the time with the banjo electric bass conjunction in the rhythm section, and I feel the right sort of pianist and guitarist could have helped a lot. I hesitate to make this criticism in the light of Koch's beautiful banjo playing. He excels at the opening of The Mooche, repeating tastefully a very telling phrase. Lisen to him too behind the solos of Grah and Munro. This is the way to play jazz banjo.

He's a merry soul too, singing and taking solos on I Wannta Go Back to Bali and Tiger Rag in a style that makes you think immediately of Melbourne's Graham "Smacka" Fitzgibbon. I'd love to hear them have a duo workout at a jazz convention.

On the sleeve notes, Adelaide jazz buff Don Porter says: "I have considered Bill Munro one of the triumvirate of outstanding jazz trumpeters in Australia, the other two being Bob Barnard and Roger Bell"

I'll go along with that – and further, to make it a quinquemvirate (if we must indulge in Latinisms) by adding Ken Flannery and Tony Newstead.

Munro is a sterling player. He can play with superb attack, as on King of the Zulus, Tiger Rag and Kansas City Man Blues, and he can embellish a ballad, as on Sunny, Mood Indigo and Autumn Leaves. There are echoes of Chet Baker, al of all people, in the opening chorus of Stranger on the Shore.

Gray is the perfect clarinettist for this sort of group. His playing always conveys an impression of poise. He's never ruffled. He seems to float through his solo on Autumn Leaves, bends the notes beautifully on Sunny (played as a delightful slow) and takes a great lower register solo on the rarely heard verse of Black Bottom.

According to Porter, Gordon Coulson, who comes from England, "is certainly one of the best jazz trombonists in Adelaide." Either Porter is a pastmaster of understatement or there are a lot of trombonists in Adelaide I haven't heard.

Coulson is the only Australian jazz trombonist who in any way reminds me of Jimmy Harrison. Harrison may not have influenced him, but there are touches of his style in Coulson's solo on the title track. He takes two loose-limbed choruses on Savoy Blues and gets some modern licks into his solo on King of the Zulus. He is possibly the best soloist on Mood Indigo, on which he and Gray play beautiful figures behind Munro's muted trumpet chorus.

So What's New is much tidier than most Australian traditional jazz records, but is not tightly arranged and certainly doesn't sacrifice any fire for the sake of tidiness. I guess it has an Australian sound, but I may not have picked it if had not known in advance it was an Australian record. Certainly it's not an aggressive Australian sound. Certainly, it's a very fine record. – B. W.

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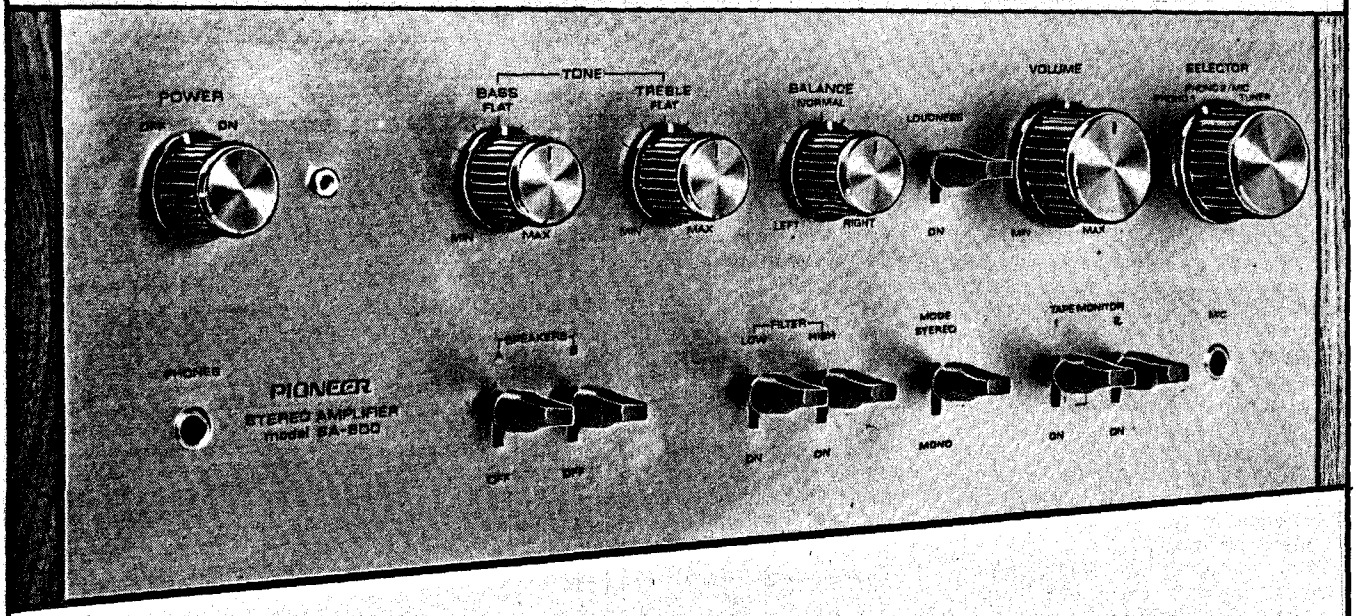

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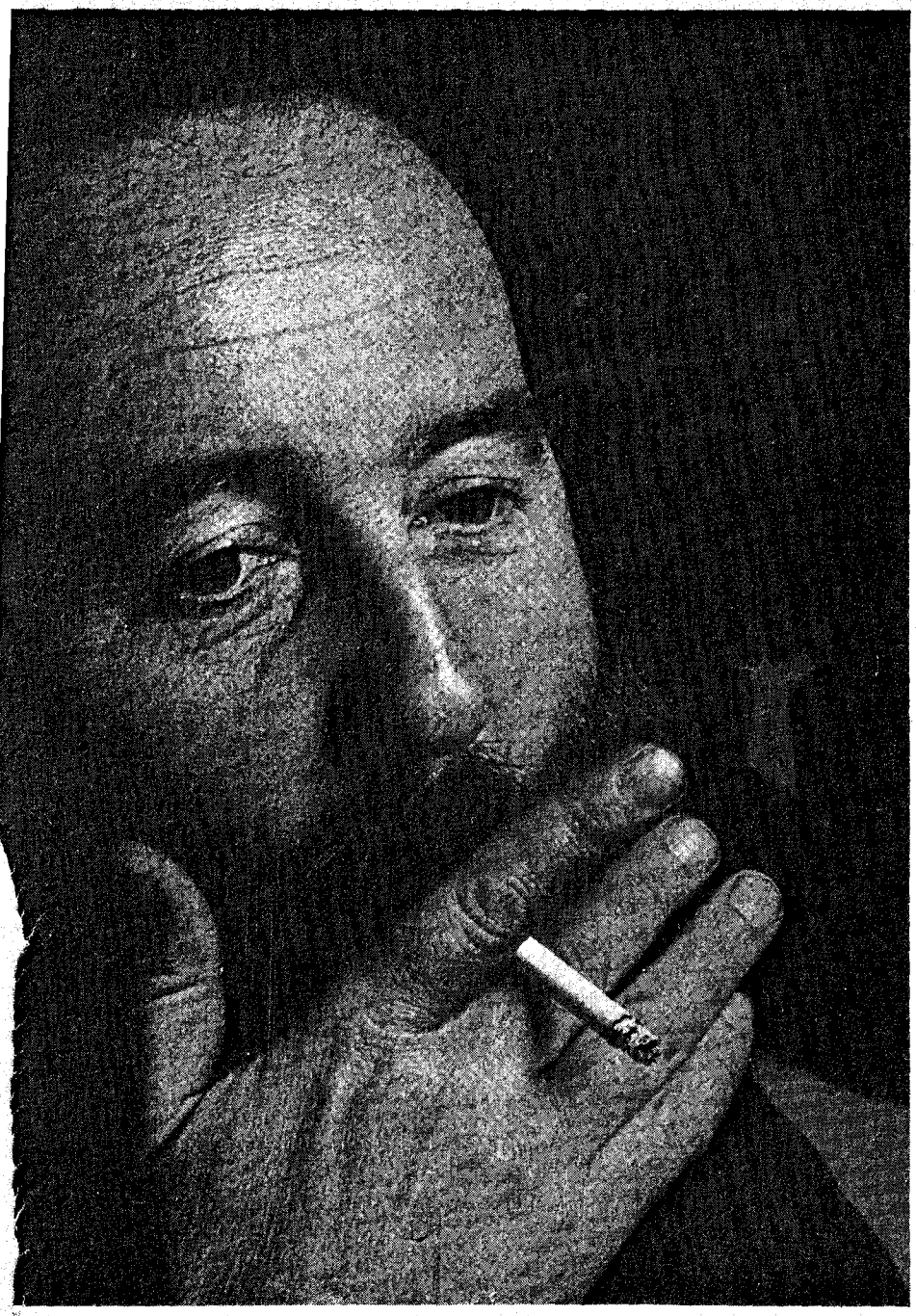

YOU could be excused for thinking of John Sangster as some kind of artistic chameleon, so easily does he move from one musical world to another. Traditional jazzman, modern jazzman, Hair musician, underground and experimental jazz musician, and now a composer of film scores – he seems right for every part, but any change in John Sangster is purely in the eye of the beholder.

John began in traditional jazz with the Graeme Bell band in Melbourne, playing trombone for a while, and then cornet. When the Bell band went on its second tour of England in 1947, they found themselves minus a drummer. Sangster taught himself drums on the ship and remained on drums with the Bell band for the rest of the two-year tour. In fact, he played with Graeme on and off for ten years, before joining Ray Price.

If you have seen John Sangster playing traditional jazz, you will surely have noticed that while he is playing it, he looks like the typical traddie: Bearded, twinkling, at once dedicated and jolly.

Many traditional jazzmen are not like this at all once they leave the stand. Then you may find them absorbed in an old womanish fussy sort of way in names and dates of legendary recordings, and often filled with bitterness at those who have forsaken traditional forms. This is a very sweeping statement, and in fact, two traditional jazzmen at least – Graeme Bell and Dick Hughes – are amongst the most open minded people I know, but many are just as I have described. Sangster, however, is one of those who is just the same off the stand, and that is the Sangster paradox: He stays the same, he fits everywhere. Or is it paradox?

While with Ray Price, Sangster became interested in the vibraphone and with the beautiful and funky sounds being produced on the instrument by modern jazzmen. Soon he began teaching himself ("like a fool" as he says) composition. "I wanted to write more, because I was never satisfied with playing the same tunes all the time. Even if you are going to do a jazz improvisation you may as well start out with a theme that is beautiful in itself, and many of the things jazz musicians use as vehicles are not particularly beautiful." His interests in percussion

Leading a jazz group, playing in Hair, writing for films, Sangster is still Sangster.
– a sketch by John Clare.

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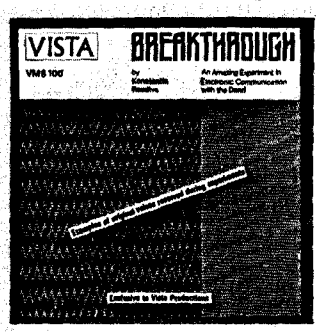

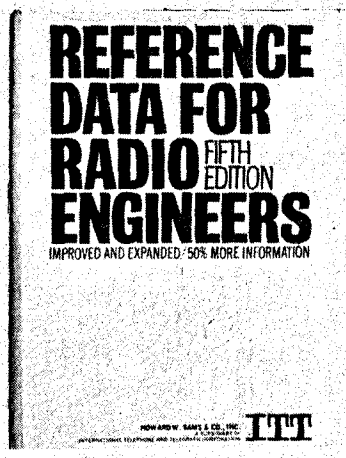

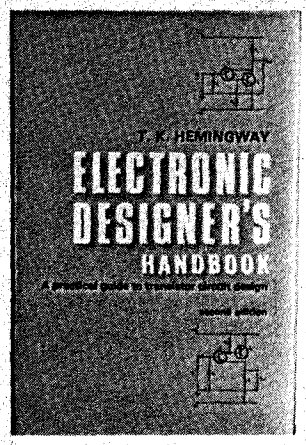

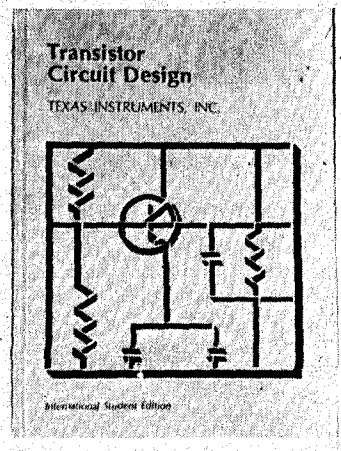

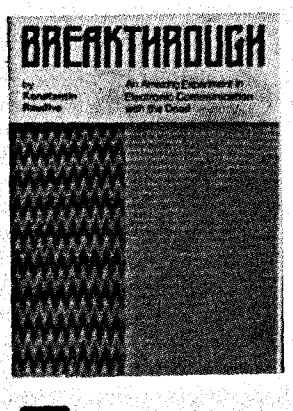

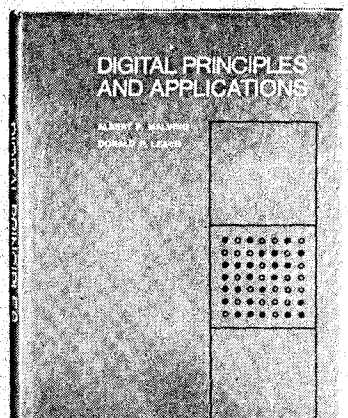

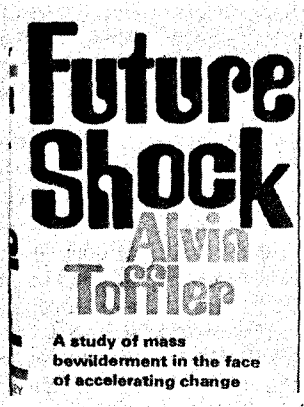

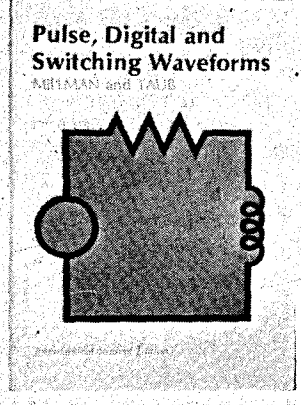

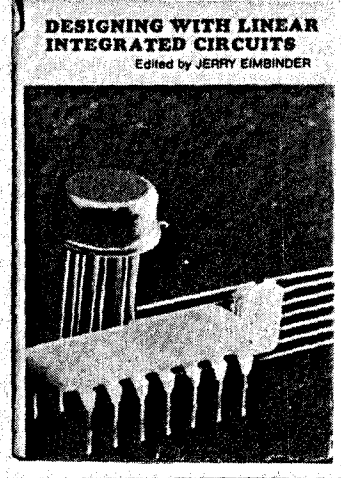

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THE SEVERAL WORLDS OF JOHN SANGSTER

also broadened at this time. Beginning with an interest in Latin rhythms, he began to explore the possibilities of a great range of rhythms and percussion instruments.

Today we see Sangster as the typical modern jazz musician: Bearded, serious, coolly amused at some new rhythm or chord, completely dedicated and unsentimental. Look again. Same old Sangster.

But here's an odd thing. For all their being called intellectual, radical, disrespectful of the past, most modernists outside their music were no more intellectually involved than, say, your average bank clerk. It was not unusual for a trad man to be a radical thinker in everthing but his music while a modernist might be in everything but his music, quite reactionary or apathetic. It was often my experience to find the modern player quite ignorant of the other arts, while the traditionalist was at least vaguely aware of developments in painting and literature.

Again, off the stand we find Sangster to be more consistent with the image he projected than were most of his fellows.

When the poetry and jazz thing came along, Sangster had at least read some poetry. In fact, he and Don Burrows excelled themselves in a late night programme on ABC radio, where they would follow the reading of a poem with an improvisation. Already John Sangster was thought of as the most consciously artistic of Sydney jazz musicians.

But if you happened to turn on the TV at the wrong time – there would be John in his dinner suit playing in the 'Sound of Music'. Here, and only here did he have a faint air of being caught out, yet here I often felt was the essence of John Sangster, Sangster reduced to his most basic nature: A good humoured but mischievous boy forced to don a suit for dancing lessons, or for big sister's wedding, all the time holding back an evil leer at his mates who are watching from the sidelines, doubled up in amusement.

Yet, if it is not difficult to imagine Sangster in a school cap, it is a surprise to stand beside him and find him not quite so big as you'd thought. He has the features – the full nose and high forehead – of a large man. He is a medium sized man. His eyes are a little smallish; soft, intelligent and full of humour. Like the amused eyes of an elephant in a Disney cartoon.

The time soon came when Sangster felt that 'Modern' jazz in Australia had fallen into stultifying conventions. He was well aware that black jazz musicians in America, such as Sun Ra, Archie Shepp, Ornette Coleman and Pharoah Sanders were exploring a new musical world, but it was not happening in Australia. In fact, the only area in which he could find the freshness and energy which jazz had relinquished was rock music. He went back to drums for a while, playing with Col Nolan at the Whisky A Go Go, a sort of jazz rock repetoire. Occasionally he organised a band which would include some of the more adventurous Sydney musicians, and played at underground concerts.

With his musical experience, particularly his knowledge of percussion and his interest in rock music, he was the natural choice to handle the percussion and generally organise the band in Hair when it opened in Sydney.

Love, Peace, everybody smile. Sangster had never stopped smiling. With his battered apparel, his thin on top, long back and sides haircut, his grizzled beard, he fitted in there too, almost as a kind of Ginsberg figure.

Same Sangster.

Sangster stayed two years with Hair, interrupted by a trip to the Osaka 'Expo' with the Don Burrows group, pop singer Judy Stone and a troupe of Aboriginal dancers and musicians. It is interesting to note that the Hair band consisted of the group Tully, plus Freddie Payne and Keith Stirling on trumpets, Michael Barnes from the jazz-rock group Nutwood Rug on guitar, and Sangster on percussion and amplified vibes. Nutwood Rug which included the great Keith Barr on tenor, and Tully, a much ballyhooed but nevertheless interesting group, were both using elements of the new jazz. I remember writing back then that . . . "in rock and in the new jazz are the elements of a music of unprecedented power." Some will disagree, but I think Miles Davis has come near to proving me right.

About this time he began writing music for underground films, one, 'Marinetti', was notable only for his music and the brilliant camera work of David Perry.

Film music is now John Sangster's main preoccupation. He has moved from his rooftop flat in Kings Cross to a house by the Narrabeen Lakes. He works on such projects as Peter Brett's "Full Stop", a promotional film for the Ferrodo people: "Very abstract, very adventurous" – 'The Funky Phantom' for Bill Hanna of Hanna Barbera, who is making cartoons in Australia now, because it's cheaper. He is not interested in doing a feature film until he has served a self-imposed apprenticeship on smaller projects. He paddles about the lakes in a canoe while he is resting or thinking over an assignment, he smiles the Sangster smile, and there we leave him, skimming, drifting, slowly spinning, smiling the while, off into obscurity.

Not exactly!

One of our few great and original

THE SEVERAL WORLDS OF JOHN SANGSTER

jazzmen, Keith Barr, died recently. A benefit was arranged at the Musicians Club for his daughter. Who is there, making many a heart rejoice as he shows just how exciting, vital, free and adventurous jazz can be? None other than the John.

"Here is John Sangster, fine musician and all-round good fellow," says the President of the Musician's Union. Sangster, eyes glittering, makes a strange loose bearish lurch with both mallets toward his vibes, and music such as many people there have never heard, joyful, intense, polyrhythmic, fiery and ethereal; rolls forth.

I hear somebody behind me say, "You know this is the real underground music" Right on, I say to myself. Right on.

Keith Stirling is on trumpet, blowing the same kind of fierce, jagged, hyper-intense horn that Miles Davis plays on 'Miles At The Filmore'. He whips the rhythm section up until it hums like a dynamo, then he begins to sway and pour forth streams of lyrical beauty. Sangster reacts to everything. When he doesn't play a counter phrase on the vibes, he just throws his head back and laughs. I am laughing inside. This is today's jazz, and everybody is digging it, everybody is overwhelmed. This is Sangster's strength. He has the presence to weld musicians together with no rehearsal, with the barest framework laid down beforehand, and he draws the best from them.

On the drums is Jack Dougan, whom I met in London when he was playing with visiting American greats at Ronnie Scott's, and he was the last drummer to play with Keith Barr. Jack Dougan is quite insane. He is a Scot with the only red Afro haircut in captivity. When he has to lay out, he snuffles and shuffles his feet like a fighter waiting for the bell. He takes one solo on his face using the palms of his hands. His face goes as red as his hair, and it brings the house down. He is playing like a man possessed. Derek Fairbrass, on congas, leans over and takes a solo on Jack's kit. Jack leaps up, keeping the time with his foot pedal and mock-abuses Derek for four bars. Derek is laughing too much to play. The proceedings rage on until six o'clock of the next morning.

Sangster is back in town the next day to attend the screening, in the Sydney Museum, of Howard Hughes' conservation films, for which he has written the music.

Four, of a series of thirteen films sponsored by BHP, have been completed and a recording of the music — called 'Australia and all that Jazz' — will have been released by the time you read this. There is a good chance that some of these will be seen on ABC TV, though they, of course, in colour and, Howard Hughes (not the millionaire) says that there has already been quite a bit of overseas interest.

John answers all questions easily, managing to draw everyone in to share his current interests: Nature, meditation, aboriginal music. An elderly lady is enthralled by his description of the way Aboriginal dancers spiritually 'become' the animals and birds they are mimicking. She sees in this some mysterious connection with demonstrators, whom she begins to harangue. Sangster's face goes carefully blank. Then, with a look of keen humourous interest in anything and everything, he prompts some more questions from the group standing about him; but now the films are ready to roll.

Using such men as Don Burrows, George Golla, Errol Buddle and Bryce Rohde, Sangster has created a clear, miniaturised but brilliantly vivacious sound world to complement the exquisite images Howard Hughes has recorded so lovingly: a new minted pea green frog, insect water walkers treading the sumptuous fat mattress of surface tension on a pond laved with limpid blue oil of the sky, mile deep clouds and the turned elegant slivers of leaves of upside down eucalypts; a field mouse trembling and darting. Talking quietly with John through the films, I get an impression of complete enthralment in the images with which he has been working. "Look at that", he says, far more often than he asks you to listen to something. During that last film, which is about seals, I tell him that he has got a certain part just right. "Great." I say "You got it."

The scene is of seals undulating down a gentle rock slope, heads pumping rhythmically, as though they are going to skate out on the level surface of the sea rather than slide beneath it. The sound of the vibes seems to roll but over the smooth swells in gentle billows of pellucid sound. "You liked that?" he says. "I tried to write curved shapes there." "Yeah" I say. He nods. I can feel rather than see his eyes twinkling in the dar.

Then: "Now this is really something. I had to write music here for two seals making love. Look, she seems to be enjoying it so much, I tried to get that."

I don't suppose I've looked properly at seals. This one is really beautiful, preening herself before the act.

I know John Sangster is smiling. — J.C. ●

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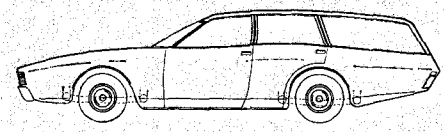

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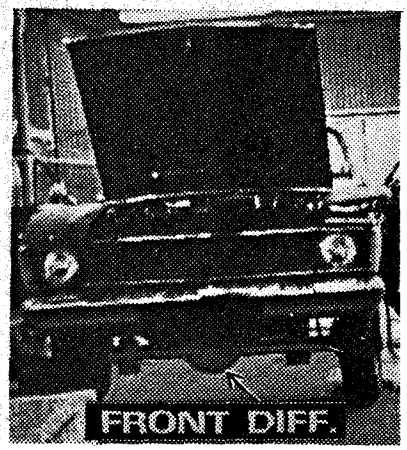

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BOOK REVIEWS

REVIEWER: Brian Chapman
Jan Vernon

"BASIC ELECTRONICS". Prepared by Bureau of U.S. Naval Personnel. Published by Dover Publications Inc., New York. Revised edition 1968. 538 pages 9¼" x 6½". Soft covers. Available from Modern Books and Plans, Sydney. Australian price $4.55.

This Dover edition, first published in 1969, is an unabridged and unaltered re-publication of the revised 1968 edition of the work that was originally published by the United States Navy Training Publications Centre in 1955. The text is designated by the U.S. Navy as Navy Training Course NAVPERS 10087-B.

In the preface we are told that electronics is something which aims guns, drops bombs, navigates ships and helps control engineering plants. Don't be put off by this martial introduction, the book really is about electronics. Neglecting the obvious slant towards things Naval, this is perhaps one of the best value for money, basic texts available today.

The training manuals of the U.S. military forces are always of the highest standard. No expense is spared to produce a well written and illustrated text that provides all necessary information on the subject matter with the utmost clarity. The present volume is a prime example of the general standard of these works.

The text commences with discussions of electron tube and semi-conductor devices and then proceeds methodically through the following:

Power supplies.
Tuned circuits.
Amplifiers.
Oscillators.
Special circuits.
Modulation and demodulation.
Transmitters and transmission lines.
Antennas and propagation.
Ranging and navigational systems.
Introduction to computers.
Electronic test equipment.

Following the main text, there are seven appendices some of which are only applicable to the Navy, but in the main contain much useful material.

In each discussion of a particular type of circuit the electron tube versions are discussed first and then the transistorised. Both are treated very fully and to a level which would be adequate for the highest standard of service technicians.

Electron circuitry perhaps has more emphasis than semi-conductor and this is one of the few criticisms that can be made of this book, as electron tubes these days are rapidly disappearing from the scene. In fact, the new generation of technicians will probably never see valves except in rare high power, high frequency equipment.

Although the book has soft covers, it is very well bound and should last well. The type face used, although small, is quite legible and the quality of paper and printing is outstanding.

An excellent reference or self study manual for technicians, one well worth purchasing. – B.C.

"A GUIDE TO RADIO AND T.V. BROADCAST ENGINEERING PRACTICE" by E.L. Safford Jnr. Published by TAB Books March 1971. Hard Covers, 5½" x 8½", 282 pages. Australian price $16.20. Available from Modern Books & Plans and other leading booksellers.

This book is the result of a study of current engineering practices and procedures in the broadcast and television industries in the United States. The information was gathered by interviewing engineers and technicians, manufacturers and consultants and the U.S. controlling body, the FCC. This was done to obtain an insight into the procedures and problems peculiar to the industry.

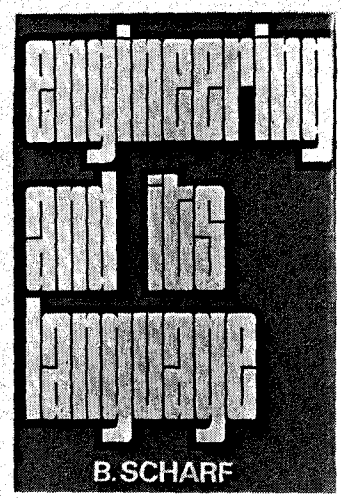
Australian readers, of course, will have to sift out the FCC regulations and requirements which are different from those laid down by the Australian Broadcasting Commission, but even so, the material contained is very interesting and informative. Particular emphasis is placed on the servicing and maintenance routines employed in the U.S. and no doubt these are very similar to those used here – some stations are lax in this respect and some are painstaking. Generally, station efficiency reflects the efficiency of the maintenance programme and the valuable data and statistics included in this manual should considerably assist maintenance people to increase overall efficiency.

A study of the derivation and use of MTBF figures (mean time between failures) is given which I have not seen treated as thoroughly in any other text.

The book is divided into two main sections. These are, radio, and television. Each section deals with maintenance philosophy, case histories of failures, typical equipment etc. for each discipline. In addition, there are chapters on the more common FCC violations, the qualifications of consulting engineers and what one's salary should be. Although these latter chapters are not applicable to Australia, they are none the less interesting.

Those people entering the commercial radio or television fields would find plenty of interesting material in this book. Indeed, it would be perhaps quite invaluable in the U.S. The equipment described would not be so common in Australia and techniques, of course, are different. But basic theory is not, and there are plenty of worthwhile hints and data which would be of value to anyone active in this field.

The book is quite expensive and in my opinion would be worth the money only to those directly involved in the radio and T.V. industries. It is well written, clearly understandable, but is spoiled by poor quality photographic reproductions, which all have a murky blurred appearance. There are quite a number of photographs in the book and it is a pity that a little more effort has not been put into this area. – B.C.



ENGINEERING AND ITS LANGUAGE – by Bedrich Scharf, B.A., F.I.L., published by Frederick Muller Ltd., London, 1971. Hard covers. 400 pages. Price $19.50 available from Modern Books & Plans and all leading booksellers.

Written not by an engineer, but by a linguist who specialises in technical translation, this book is intended as a source of background engineering knowledge for industrial translators and technical writers.

A wide range of engineering topics are covered. The book starts with engineering materials, and covers metalworking processes, plastics, machine tools, steam power plant, engines, mechanical handling equipment, earthmoving equipment, mixers and mills,

BOOK REVIEWS

electricity and electronics, process instrumentation, etc.

The author's intention is to outline very many aspects of engineering and no attempt has been made to go into great detail with any subject. As an example transistors are described as follows – "Transistors – these are semi-conductor devices that are used instead of thermionic valves for such varied applications as electronic switches, amplifiers and oscillators." "Transistors basically consist of three layers of semi-conductor material such as germanium or silicon combined in a sandwich construction." The two outer layers (known respectively as emitter and collector) may be negatively conducting with a thin control 'wafer' (base) positively conducting (npn), or vice versa (pnp)".

There is also a clear line drawing of a transistor along with the description. The book has 343 of these drawings to amplify the text. There are also 28 pages of photographs, as well as 33 conversion tables and a comprehensive 38 page index.

The author intends the book primarily as a text book for technical writers and translators, but it also has some value as an elementary work of reference.

For people using the book as a background course, a section of revision questions is included covering the information from each chapter.

Although written for readers without an engineering background, 'Engineering and its Language' would also be valuable for a person who has specialised in one branch of engineering but who also needs a basic knowledge of other branches. The book is particularly useful for checking correct terminology.

It is not, however, an engineering text book as such and the treatment of nearly all subjects is necessarily superficial. – J. V.

REFERENCE DATA FOR RADIO ENGINEERS – Fifth Edition 1968. Published by Howard W. Sams & Co., Inc. New York. A subsidiary of International Telephone & Telegraph Corporation. 1164 pages 6½" x 9½", hard covers. Australian price $25.

The fifth edition of Reference Data for Radio Engineers grew from a 60-page brochure of that title originally compiled by W. L. McPherson of Standard Telephones and Cables Limited, published in England in 1942. Its immediate acceptance prompted the parent company, International Telephone and Telegraph Corporation, to arrange for a United States version that in four editions dated 1943, 1946, 1949, and 1956 had a total sale of 350,000 copies.

The present volume contains about 50 per cent more material than the fourth edition. It was compiled by over 100 engineers – each contributing in his own field of specialisation.

This is a difficult book to review, in that the subject coverage and material content is so vast that one cannot read it as one would a normal text book. Some indication may be given by the fact that the 42 chapter 1164 page book has a 41 page index, with 200 references per page, that is over 8,000 references.

The book is a true reference manual, not a text book, it gives all the relevant charts, equations and definitions required by engineers or technicians who *are already familiar with the field.* For example the section on radar is only 14 pages, no attempt is made to explain or even illustrate typical radar circuits. Rather the section covers antenna gain equations, target echoing area and height equations, radar range equation, typical CRT displays and CW and doppler radar characteristics. The entire work is crammed with monograms, tables and graphs covering the range from normal mathematical tables, units, constants and conversion factors to nuclear physics, quantam electronics, probability and statistical equations, etc. etc.

The subject matter is extremely wide covering such diverse subjects as the 'properties of materials' and 'space communications'.

Old timers like myself (! – Ed.) would perhaps compare this book to the Radiotron Designers Handbook, that classic work which although last published (as the fourth edition) in 1953 is still used as a reference manual today despite its material being allied to valve radio and amplifiers circuit only.

In today's world where electronic engineering has assumed far greater importance than the radio and electrical engineering of 20 years ago, this book fills a vital need.

As a reference work it is unique, there is not another electronic text available today which has such a wealth of content.

The price is high at $25 but the book is well worth it. I have no hesitation in saying that every electronics engineer would find this book useful for many years to come. – B.C.

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ELECTRONICS TODAY MICRO ADS RATE IS ONLY $7.50 PER SINGLE COLUMN INCH OR 76c PER LINE. TO PLACE YOUR MICRO AD, MERELY FILL IN THE FORM BELOW AND SEND TO ELECTRONICS TODAY, MICRO ADS, 21-23 BATHURST STREET, SYDNEY, 2000.

BARGAIN Leak Stereo 20 amplifier and pre-amplifier. This unit produces a genuine 25 watts per channel. Excellent condition – $145. Post Box 130, Paddington N.S.W. or telephone 3719460 evenings after 7 p.m.

50 ONLY SCRs – C106 Y1 – 75 cents each in minimum lots of 10. Vernon Engineering, P.O. Box 130 Paddington, NSW.

HIGHLY PROFITABLE radio, T.V. service, rentals, sales business in Brisbane's fastest developing suburb – 1600 service regulars increasing 40/50 p.m. unlimited potential – modern freehold shop with accommodation – main highway position – $29,500 s.a.v. Replay: – Radio & T.V., 33 Harding Street, Petrie, Q. 4502.

LOWEST PRICES in Australia. Magnavox 8-30 cabinet kits. Maple/Walnut $20.00, Blackbean $21.00, Teak $23.00. Packing $3.00 ea. Extra freight payable on delivery available from Robert N. Smallwood Sound Specialists, 205 Brisbane Rd., Booval, Ipswich, Qld. Ph. 82 1550.

INVERTERS TRANS 12 V to 240V, 50 Hz, 120 W $55.00 plus S. T. Paris Radio Electronics, 7a Burton Street, Darlinghurst. 31 3273.

CRYSTALS . . . for CB 27,240 and 26,785 MHz, ¼ in. pin, miniature, $6 pr. Post Free, SHALLEY, 127 York Street, Sydney.

MICRONICS for new, guaranteed MICRO components at MICRO prices.

SEMICONDUCTORS – EM401 (In4001)-20c, A91-20c, BC107-50c, BC108, 109-45c ea., AC127, 128-60c ea., AC187, 188-75c ea., C106B1-$1.50.

RESISTORS – Carbon Film, ¼W, 5%. High stability, insulated cracked carbon with average tol. of 2%. E.12 values 10-10M 5c ea.

POLYESTER FILM CAPACITORS Subminiature "GREENCAP". Top Quality. 100VW: .001, .0015, .0022, .0033, .0039, .0047, .0056 .0068, .0082, .01, .015, .022 – 10c ea., .033, .039 – 12c ea., .047, .056 – 14c ea., .068, .082 – 16c ea., .1 – 18c, .15 – 20c., 22 – 22c.

ELECTROLYTICS – High stability, miniature, single ended, 25VW: 4.7uF – 15c, 10uF – 17c, 25uF – 19c, 47uF – 21c, 100uF – 24c, 200uF – 28c, 470uF – 38c, 1000uF – 58c.

PRE-SET POTS Miniature (10mm) Top Grade P.C. Board mount. Range 500, 1k, 1k, 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M, 2M only 20c ea. Post Pack 20c. Send 9" x 4" S.A.E. for Catalogue. MICRONICS, P.O. Box 175A, Randwick, N.S.W. 2031.

CHATTERBOX RECORDING CLUB offers Sound Mag Country and Western tapes Round Robins Tapespondence Sales News Letters $3.00 per year. P.O. Box 118, Wellington, 2820.

REPAIRS to receivers, transmitters, construction testing: T.V. alignment, Xal conv., specialised electronic equip. Eccleston Electronics, 146a Cotham Road, Kew, Vic, 80 3777.

RESISTORS: Carbon film 1/20 Watt 38c ea. 1/8 watt E24 Values 6c; 2N1613 – $1.93 2N2926 Brown $1, Yellow $1.05, Red $1.10, Green $1.15; 2N3053 – $2, 2N3704, 2N3705, 2N3706, $1.33 ea. BC178 84c; BFY51 $4; BSX20 $1.80. Post Packing 10c per order. HOBIPAK, Box 224, Carlton South, Vic. 3053.

RELAYS 516 S.T.C. miniature 250g.g.o. – 2 CO/H.D. 1,000 ohms 20-42v. with rectifiers A/C D/C $1.80 ea. Push switches 550 RAFTI illuminated 2 CO momentary 24 v. lamps cat 11-5101 $1.50 each. Phone Mr. Gordon 54 2064 (Sydney).

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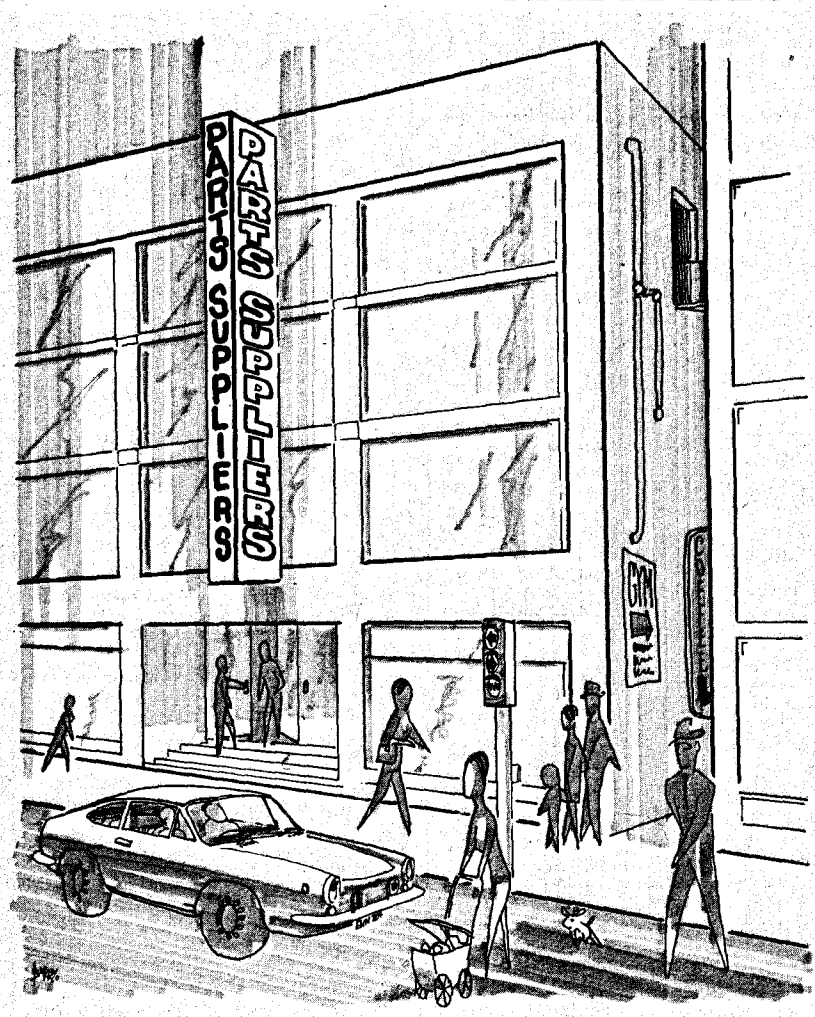

THE COMPANIES LISTED ON THIS PAGE STOCK KITS AND/OR PARTS FOR "ELECTRONICS TODAY" PROJECTS. THEY DO THEIR BEST TO HAVE ALL PARTS AVAILABLE AS SOON AS POSSIBLE AFTER PUBLICATION.

HOWEVER IT MUST BE APPRECIATED THAT DUE TO THE VAGARIES IN SUPPLY AND DEMAND THERE MAY BE OCCASIONS WHEN A PARTICULAR PART OR KIT CANNOT BE SUPPLIED DIRECTLY FROM STOCK.

WE WILL EXTEND THIS SERVICE TO COVER ALL STATES AND NEW ZEALAND AS SOON AS POSSIBLE.

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EDGE ELECTRIX: 25a Burwood Road, Burwood, Telephone 747-2931.

INSTROL: 91a York Street, Sydney, Telephone 29-4258.

KITSETS AUSTRALIA: Suite 2, 21 Oakes Avenue, Dee Why, Telephone 982-5571.

NATIONAL RADIO SUPPLIES: 332 Parramatta Road, Stanmore, Telephone 56-7398.

PRE-PAK ELECTRONICS: 718 Parramatta Road, Croydon, Telephone 797-6144.

RADIO DESPATCH SERVICE: 869 George Street, Sydney, Telephone 211-0191.

DICK SMITH: 10 Atchison Street, St. Leonards, Telephone 43-1414.

VICTORIA

E.D. & E.: 232 Flinders Lane, Melbourne, Victoria, Telephone 63-3596.

J.H. MAGRATH & CO.: 208 Little Lonsdale Street, Melbourne, Victoria, Telephone 663-3731.

S.T.A. ELECTRONICS: 392 Centre Road, Bentleigh, Victoria, Telephone: 97-4832.

SOUTH AUSTRALIA

GERARD & GOODMAN: 192-196 Rundle Street, Adelaide, Telephone 23-2222.

INPUT GATE

LETTERS FROM OUR READERS

WHAT'S A WATT (RMS)?

Following our recent article What's a Watt (Electronics Today, July 1971) we have received the following letter from Professor J. Robert Ashley, of the Department of Electrical Engineering, University of Colorado, U.S.A.

A Watt (RMS) is a term invented by some marketing manager. There is more truth than jest in this statement because my memory of the beginnings of "Watts RMS" is that the term first appeared to counter the claims of several firms who had their amplifier powers neatly doubled in the marketing department by advertising peak power rather than average power.

A further way to inflate (bigger numbers sell!!) an amplifier rating (especially one without a regulated power supply) is to apply a short tone burst and measure peak power with an oscilloscope and precision resistor. Of course, the length of the tone burst is less than 1/10 the time constant of the power supply filter system.

As a final touch, one can put a variable auto-transformer on the main power input and operate the amplifier at 230V + 10% – remember that power is proportional to V^2/R. Never mind that the user won't duplicate this condition.

So, I suppose it is absurd of me to get up-tight about some other marketing manager (who's name is unknown to me) going into a rage about his competition advertising an amplifier similiar to his 50 watt job at "150 watts" without qualifying the test conditions and the use of peak rather than average power. With great indignation and determination to keep truth in his advertising, he coined "Watts (RMS)" to indicate that his 50 watt rating is a truthful one.

What kind of a unit is this? What is a "Watt (RMS)"? Let us attempt to theorize. The watt is the M.K.S. unit for power and usually designates a time average unless specifically called peak or instantaneous. The initials RMS stand for "root mean square" and denote a mathematical process of taking the square root of a mean (an integral) of a squared quantity. For time varying quantities,

$$F(RMS) = \sqrt{\frac{1}{T}\int_0^T (f(t))^2\,dt}$$

If we try to apply this to find out what a watt (RMS) might be, we consider an audio amplifier driving a pure resistance of R ohms. For a case I can easily integrate, assume the amplifier delivers V cos ωt volts to this resistor. Dimensionally, to obtain a power-like quantity from the RMS process, we must start with a power-like quantity and I will use instantaneous power

$$P_i(t) = (V\cos\omega t)^2/R$$

as the input to R M S ing.

$$P(RMS?) = \sqrt{\frac{V^4}{RT}\int_0^T \cos^4 2\frac{\pi}{T}t\,dt}$$

This can be readily evaluated

$$P(RMS?) = V^2\sqrt{3/(8R)}$$

and I don't think my unknown marketing manager really wants to use this rating.

Although I scorn the term "Watt (RMS)," I do wholeheartedly agree that it is a lesser evil than the fraudulent practice of rating as peak power without specifying the test conditions.

What can the audio industry do about this sad situation?

First I suggest that what my unknown marketing manager should have coined was the term "Watts (C.W.)" where the C.W. is an abbreviation for continuous wave. This firmly implies that the power rating is an average one and that a 50-watt amplifier will make a resistor put out heat like a 50 watt soldering iron. If his amplifier will stand (on a continuous wave basis) the auto-transformer treatment, he deserves to brag about the few extra watts (C.W.) obtained by operating at 230V + 10%.

Second, the editors of our journals (in particular the ones who are responsible for the advertising) should make it clear that a peak power must be specified as such. To clearly indicate that a power rating is not on a continuous wave basis, I would require that the scoundrels trying to get the biggest number, write something like "150 Watts (Pk., 10% D.U.)." Translated to technical meaning, this says 150 watts of peak power at a 10 per cent duty cycle. As an indicator of amplifier output capacity, the rating is not without merit because music is really not a continuous wave signal.

FET FOUR-INPUT MIXER

The connections to the field effect transistors in this project appear to be reversed. – JS. St. Ives, NSW.

● The source and drain of this particular FET (2N 5459) are interchangable – it can be used either way round.

FURTHER BREAKTHROUGH

Are you seriously asking readers to believe that the voices that Dr. Raudive claims to have recorded are those of dead people? (Further Breakthrough, Electronics Today, Sept. 1971). – M.M., Scottsdale, TAS.

● Of course not. Nevertheless scientific evidence overwhelmingly indicates that a phenomenon is taking place for which there is no currently satisfactory explanation. And when world famous companies such as Pye and Belling Lee vouch for the authenticity of the experiments (as they have done – in writing) then to disregard or scoff at the evidence is parochial.

UNANSWERED LETTERS

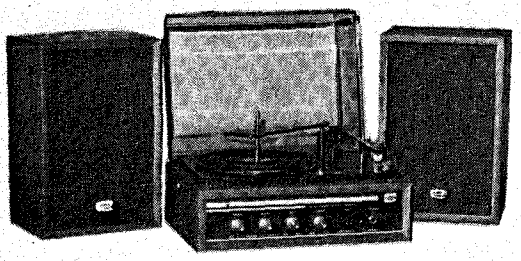
Every month we receive letters in which the sender has omitted to include his address – in fact we had two this week in which there was not even a name! Please do make sure that you include your name and address – because whilst we can only print a fraction of those received we do try to reply to them all.

HAM SANDWICH

Radio amateurs living on either side of me are causing interference to my television reception. – D.B. Frenchs Forest, NSW.

● It is extremely improbable that your problem is caused by amateur radio operators. Although such complaints are made from time to time it is almost invariably proven that the set itself is faulty or that interference is being caused by some other source. Why not discuss it with your radio amateur neighbours in a rational manner. Radio amateurs are generally knowledgable friendly characters. Few of them have been known to bite.

THE SOUND OF EXCITEMENT !!



ED - 1

Features mini auto changer, dual bass and treble controls, stereo headphones jack, din input/output socket.

Power Output: 5 watts stereo

Speakers: 2 x 6" x 4"

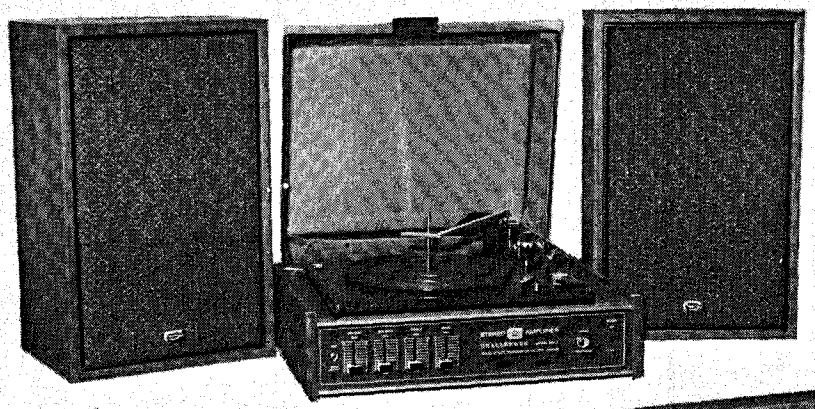
ED - 3

FEATURES: Soanar slide controls, stereo headphone jack, din input/output socket,

Power Output: 6 Watts Stereo

Speakers: 2x6" Twin Cone

Also available with radio (Model ED3 R)



ED - 6

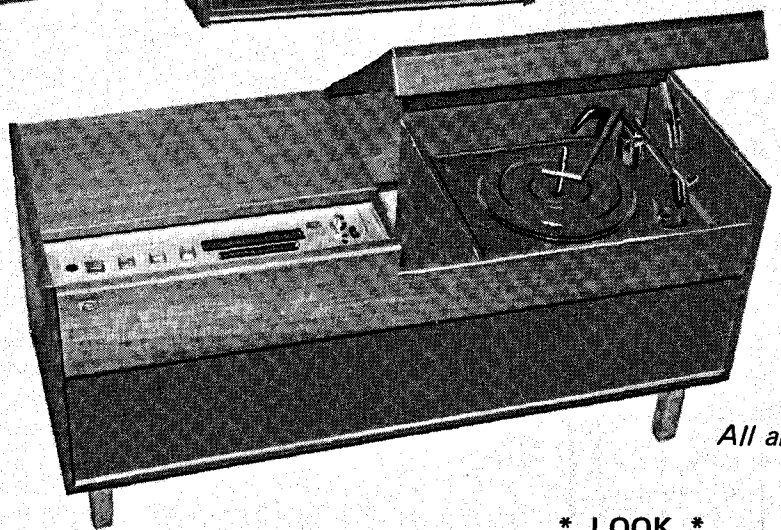
FEATURES: Soanar slide controls, stereo headphone jack, din input/output socket, slumber switch, scratch filter, rumble filter

Power Output: 12 Watts Stereo

Speakers: 2 x 8" and 2 x 3"

Also available with radio (Model ED6 R)

AVAILIABLE WITH twin (Model ED6 X)



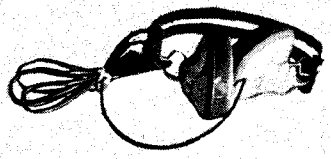
ED - 6B

FEATURES: Soanar slide controls, scratch filter, rumble filter, slumber switch, stereo headphone jack, din input/output socket radio tuner.

Power Output: 12 watts stereo

Speakers: 2 x 6" twin cone

All above units available in teak or walnut.



*** LOOK ***

On presentation of this advertisement, when making a purchase of any Expo stereo unit, a set of Expo stereo headphones will be supplied FREE of charge.

EXPO

EXPO INTERNATIONAL PTY. LTD

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PHILIPS INDUSTRIES LIMITED
Philips semiconductors used exclusively in all amplifiers in EXPO locally manufactured stereo equipment.

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GARRARD world famous automatic/manual turntables used exclusively in all EXPO locally manufactured stereo equipment.

ALCOA OF AUSTRALIA,
127 Macquarie Street, Sydney, 2000. Telephone 27-3192
Alcoa aluminium millings and extrusions are used exclusively in all EXPO locally manufactured stereo equipment.

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Telephone 69-4506
Magnavox high quality speakers are used exclusively in all EXPO locally manufactured stereo equipment.

mossburn

MOSSBURN & ASSOCIATES
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Telephone 525-3501 525-3192
Mossburn & Associates are the Sales Agent in Southern metropolitan area and Wollongong for all EXPO stereo products

A & R ELECTRONIC EQUIPMENT CO. PTY. LTD.
44-46 Lexton Road, Box Hill, Victoria, 3128
89-0238 89-0239

SOANAR ELECTRONICS PTY. LTD.
30-32 Lexton Road, Box Hill, Victoria, 3128
89-0238 89-0433
A & R transformers, Soanar slide potentiometers, diodes, resistors and Elna capacitors are used exclusively in all EXPO locally manufactured stereo equipment

THE FOLLOWING RETAILERS ARE PROUD TO MARKET THE NEW, LOCALLY MANUFACTURED RANGE OF * EXPO * STEREO EQUIPMENT

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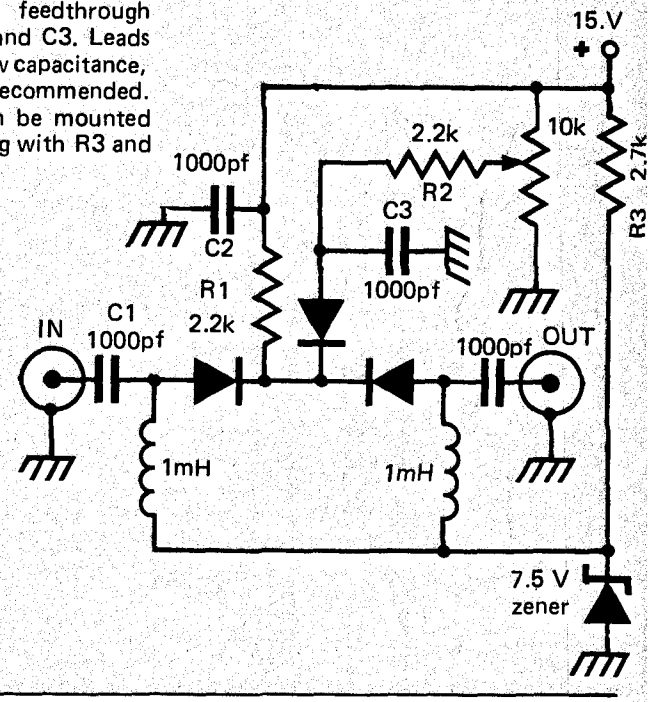
TECH-TIPS

VARIABLE RF ATTENUATOR

This circuit can provide variable in attenuation from 1 dB to approximately 40 dB.

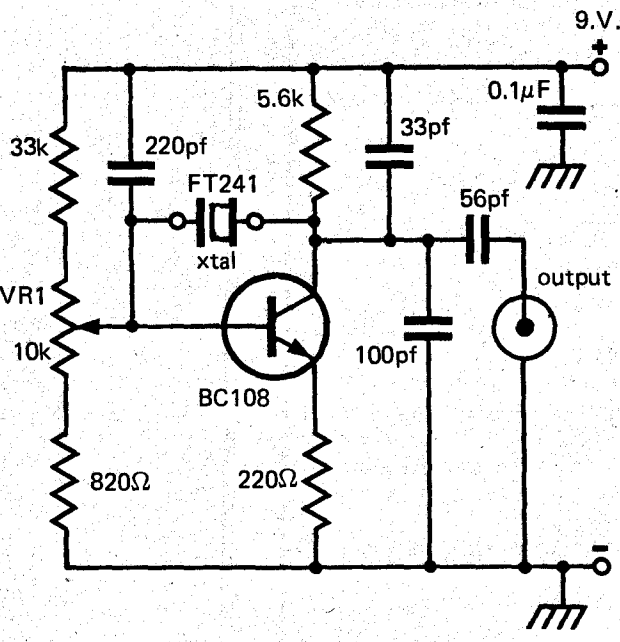
If intended for use up to UHF, the components should be mounted in a shielded enclosure and feedthrough capacitors used for C2 and C3. Leads must be kept short. Low capacitance, high speed diodes are recommended.

The potentiometer can be mounted remotely if desired, along with R3 and the zener.



TECH-TIPS

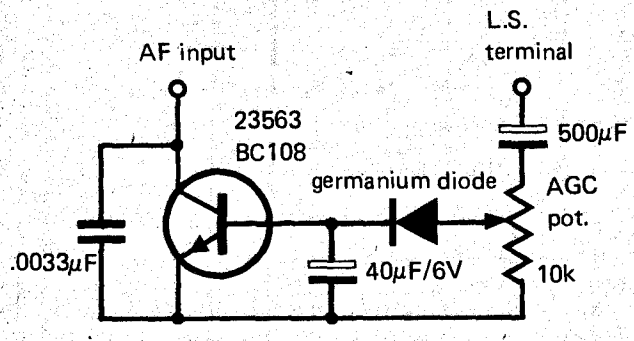
UNCRITICAL CRYSTALS



Surplus FT 241 crystals (340 to 580 kHz) are very useful in a variety of applications. But it is sometimes difficult to obtain reliable oscillation in many standard circuits.

This circuit overcomes this problem. It will provide reliable oscillation and provides an output close to one volt peak-to-peak. Power consumption is around 1mA from a nine volt supply.

SIMPLE AGC



Audio derived automatic gain control is one of the simplest methods of obtaining signal compression in a radio receiver. It is of particular value with short wave receivers used in areas where deep fading is prevalent.

The simple circuit shown here requires a minimum of components and may be used with both valve and transistor receivers.

In use, the main volume control should be set for the desired signal strength whilst the radio is tuned to a weak station, the radio is then tuned to a strong station and the AGC potentiometer adjusted to a comfortable listening volume.

CAREER OPPORTUNITIES

RADIO TECHNICIAN

Sydney's leading car radio specialists. A. W. BARRS, require an experienced radio technician for their Hornsby branch.
Car radio experience would be an advantage. Excellent wages and conditions. Superannuation available.

Phone Mr. E. Hyde on 476-1828 for appointment.

A. W. BARRS
208 Pacific Highway, HORNSBY.

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Qualifications — A First-Class Combined Steam and Motor Certificate or alternatively a First-Class Steam Certificate and a First-Class Motor Certificate as issued under or recognised by the Commonwealth Navigation Act. Applicants must also have served at sea as Chief Engineer of seagoing vessels with machinery or not less than 100 n.h.p. and/or 560 b.h.p. for at least twelve months. It is desirable that applicants have passed the examination for a Boiler Inspectors Licence as issued by the Department of Labour and Industry, New South Wales, and if not, it will be necessary that such qualification be obtained within a limited period.
Duties — Include co-ordination and supervision of workshop activities, contract inspection and programming and supervision of plant inspection.
Conditions — Liberal leave concessions including four weeks' annual leave, superannuation benefits, modern office facilities, staff cafeteria, etc. Hours of work 8.45 a.m. to 4.45 p.m. Monday to Friday.

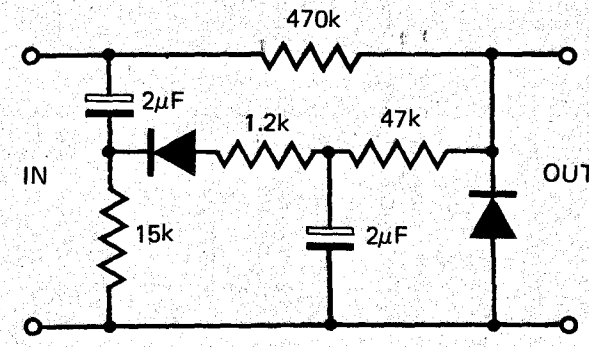
Apply by letter stating full particulars of qualifications and experience, attaching copies of references, etc., to Box 32, G.P.O., Sydney, no later than 17th September, 1971.

H. B. CADELL, Secretary.

For more information on the Careers Opportunity Columns of Electronics Today (Advertising rate 76c per line) contact:—Sydney, Howard Jenkins or Terry Marsden, 26 2296; Melbourne, Clarrie Levy, 51 9776.

TECH-TIPS

SIMPLE COMPRESSOR

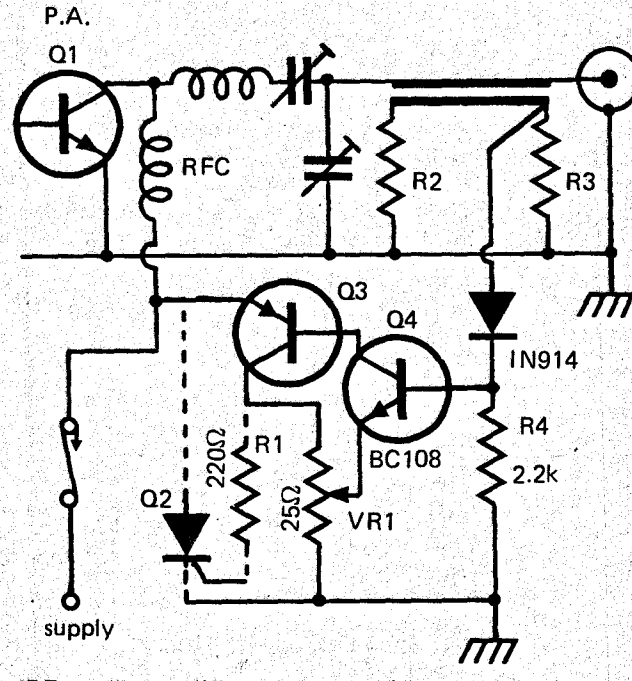


Here is a simple compressor that is very effective when recording from the speaker terminals of a receiver.

The output signal will remain at approximately five millivolts despite input variations from 200 mV to six volts.

Attack time is approximately three milliseconds and release time is approximately 100 milliseconds.

RF AMPLIFIER PROTECTION



RF power amplifier output transistors may be destroyed by high standing wave ratio loads.

This circuit senses the SWR conditions existing at the transmitter output. If the SWR exceeds a predetermined level, the PA collector voltage will automatically be reduced: in the event of a really high SWR the protection circuit will blow the supply fuse.

The SCR — shown in dotted lines — should be included if the circuit is to be used to protect a high power stage. Otherwise Q3 is used to draw an excessive current from the power supply, this transistor must be rated to dissipate the maximum power necessary to cause the fuse to blow. Potentiometer VR1 must also be rated accordingly.

The SWR sensing element employs standard SWR bridge techniques and should present no difficulties.

Make sure that you have the right size fuse though!

For further information on Advertisers listed below complete the coupon/s stating information required including company and position held (if relevant). Cut out the coupon and post to:—

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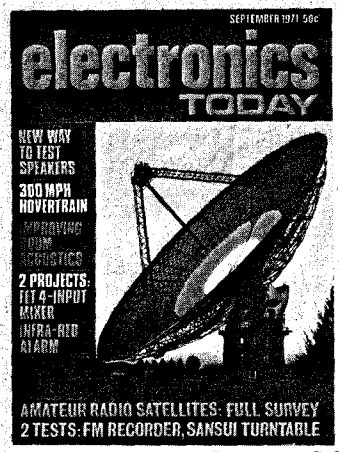

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electronics TODAY

ADVERTISERS' INDEX

Low noise high fidelity stereo

The A-1230 stereo tape deck. It has all sorts of nice professional touches like record "pause control" and a bias control for high output low noise tapes. This switch will give you a wider frequency range and a very impressive signal to noise ratio of 55 dB. Tape recordings "off the air" and from discs will take on a new dimension of fidelity with TEAC's bias control.

You can get up to four hours of uninterrupted taped performance. Four precision Technobuilt hyperbolic heads and three motors plus an all Solenoid push-button system assure superb performance.

It has a wow and flutter of 0.08% at 7½ ips. A frequency response of 30 – 22,000 Hz at 7½ ips.

If you're serious about recording your own tapes, the TEAC A-1230 is for you. And if you want automatic reverse, the A-1250's got it.

TEAC

A Sound Idea

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Phone 69 7281

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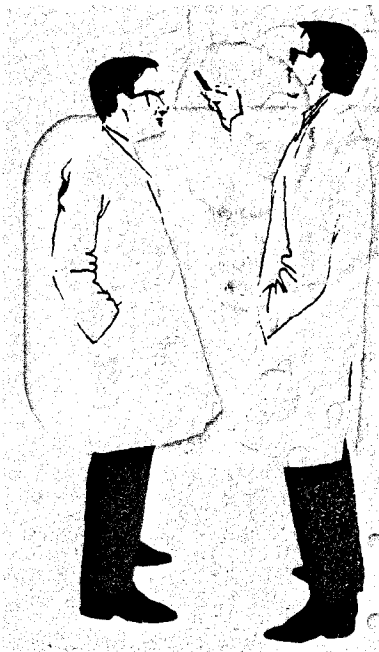
AM1135



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