AUSTRALIA'S DYNAMIC MONTHLY

OCTOBER 1972 50c

electronics TODAY INTERNATIONAL

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electronics TODAY INTERNATIONAL

OCTOBER 1972 Vol. 2 No. 7

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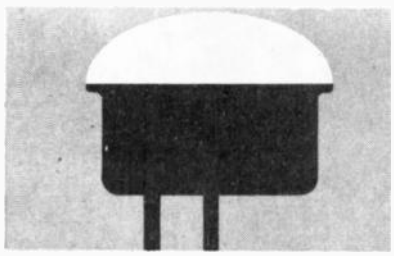
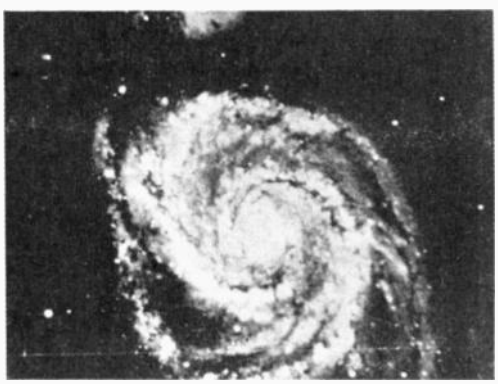
reviews

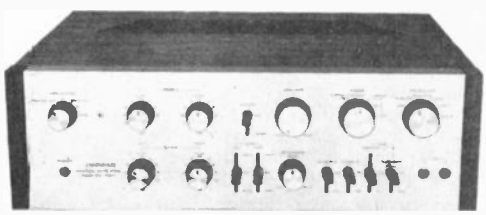
news & information

Cover: Wollongong (NSW) radio amateurs use ex-CSIRO radio astronomy facilities for earth point-to-point communication by bouncing signals off the moon.

(Details on page 103)







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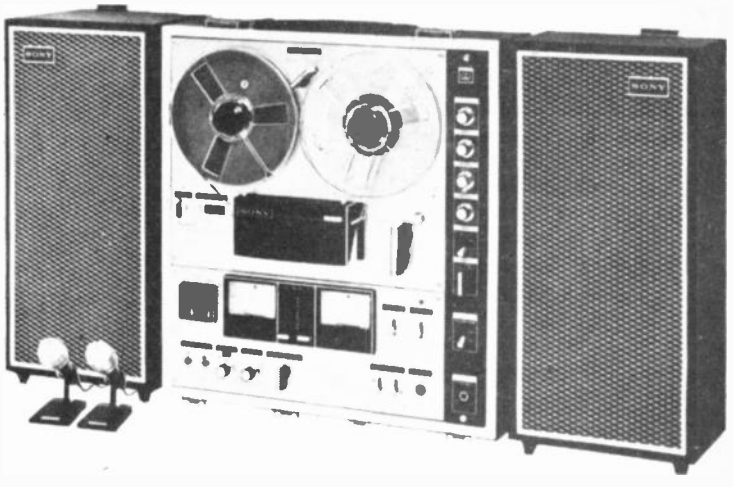

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'THE STATE OF THE ART'

Right from the earliest days of spark transmitters and crystal receivers, radio amateurs have kept up-to-date with – and sometimes even in advance of – the latest technology.

For example the world's first radio astronomer, Grote Reber, was a radio amateur and his work stands as a pioneering and classical contribution to modern astronomy and radio physics.

It is not then surprising that, in Australia today, amateur radio enthusiasts are actively exploring 'state of the art' techniques and methods of communication.

These include earth satellite communications, moonbounce, meteor scatter, tropospheric and weak signal detection. Amateurs are also experimenting with television techniques including high resolution black-and-white systems, colour transmission and slow-scan TV. In addition, a number of amateurs are exploring UHF and SHF techniques, whilst others are currently researching propagation in various fields.

Much of this work is of a very high standard and of interest to many, both within and outside the amateur radio movement. Yet it is a field of interest that is virtually ignored by the majority of electronics publications.

And so, starting with this issue, we will be bringing you news and details of these activities – and of the people running them.

This month we extend a welcome to our new staff member, Wendy Roy – a journalist with wide experience in the audio field.

Before coming to Australia last year, Wendy worked with a London publishing company for eight years, eventually taking charge of the English tape enthusiasts' magazine 'Sound and Picture Tape Recording'.

In Australia, Wendy worked on Mingay's News and Electrical Engineer, then moved to Australian Hi-Fi, from which she resigned after a few weeks to join Electronics Today International.

news digest

NEW COLOUR TUBE

Left: new RCA tube has all deflection and convergence elements bonded to neck – according to the manufacturers it is smaller, lighter, and easier to set up than conventional tube (shown on right).

A new colour CRT, introduced by RCA, in America uses an in-line, triple-beam gun structure, and a line-focus-type of static toroidal deflection yoke that eliminates the need for dynamic convergence. The shadow mask has vertically oriented slit-shaped apertures with the phosphor array forming vertical green, red, and blue lines. Dynamic convergence magnets are not required.

The three-gun assembly is arranged horizontally and is about half the size of the conventional delta layout.

A single static convergence and purity device is included in the yoke assembly which is bonded to the neck of the CRT.

The new approach produces a 1.8" shorter tube, 2½ lb lighter than present 90° systems. The new tubes will be available in 15", 17", and 19" sizes. RCA is also working on a 13" version.

ERTSA SATELLITE

This artist's impression of the Earth Resources Technology Satellite-A (ERTS-1 in orbit) shows how remote data collection platforms will collect environmental data and then radio the information to ERTS-A as it passes overhead. Some 150 of these electronic rugged platforms will be scattered around the North American continent to monitor such local conditions as stream flow, snow depth, soil moisture, volcanic activity and almost any other environmental condition. These platforms are built for NASA's Goddard Space Flight Center by the General Electric Company.

The ERTS-A satellite was described and illustrated in our News Digest columns last month.

The Garrard Zero-100:* no other turntable can do so much for your Hi-Fi system

Don't take our word for it, read what the experts have to say.

"Now and again, in the world of audio, there comes a piece of equipment that is not only different enough to catch public imagination but also technically sound enough to allay the suspicions of the ultra-conservative. Such a device is the Garrard Zero 100".
Records and Recording (UK)

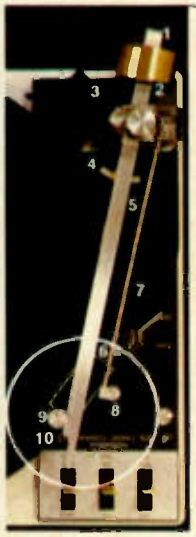
"A simple list of all the Zero-100 features should serve to spotlight the changes that have been incorporated in this model . . .
15-deg. vertical tracking angle adjustment/ Sliding-weight stylus-force adjustment — easy to adjust as little as one-tenth of a gramme/Magnetic anti-skating control/Spring-loaded tonearm safety restrictor (lock)/Long-taper variable speed control/ Illuminated stroboscope, with two bands of lines, one for each speed/Rotating manual spindle/Proven Synchro-Lab motor-combination of induction and synchronous types/Full-diameter platter/Safe 2-point record support/Handsome combination of chrome, brass and plexiglas for tonearm mounting."
Audio (USA)

"The most striking feature of the pickup arm, of course, is the auxiliary rod to the right of the straight, rectangular cross-section aluminium arm. This is pivoted at both ends and its effect is to rotate the cartridge housing directly above the stylus tip so that at all points, as the pickup tracks across the record, the plane of the stylus motion remains truly at right angles to the groove. This causes the reproducing stylus to imitate the motion of the cutting stylus very accurately in tracking the recorded waveform, and is in contrast to the normal pivoted arm which tracks in an arc across the record. The angular error is a small, but important, source of harmonic distortion".
The Gramophone (UK)

* Also available in a single player version . . . The Zero-100S which incorporates the same outstanding features of the Zero-100 and provides the facility for automatic play of single records.

For more than 50 years Garrard has led the world in turntable technology and provided millions of people with countless hours of listening pleasure. Thorough research, creative product development and rigid quality control have assured Hi-Fi enthusiasts and equipment manufacturers of consistent quality. Makers of the world's finest record players, radiograms and Hi-Fi systems have repeatedly made Garrard turntables the automatic choice for their equipment. Garrard has pioneered and introduced virtually every significant new feature in record playing units, making considerable contributions to the present high standards of high fidelity. Two "Queen's Award to Industry" the "Mercurio d'Oro" (Italy) and "Maker of the Microphone" (USA) are awards presented to Garrard as a result of their engineering achievement and progressiveness.

The models illustrated below are representative of the current advanced range of Garrard turntables. Twelve models are available comprising both automatic and single play versions to suit individual requirements.



The pivoting head at the start and end of a playing cycle.

1. Brass counterbalance weight
2. Magnetic bias compensation
3. Rigid acrylic pickup arm housing
4. Gimballed pivots
5. Stylus force adjustment (under arm)
6. Low resonance pickup arm
7. Control arm
8. Control link pivot
9. Pickup head pivot
10. Vertical cartridge angle adjustment (on auto player only)

If you'd like to read our full facts on the Zero-100 write now for colour brochure

Garrard

Plessey Ducon Pty. Limited
Villawood. N.S.W. 2163.

For further information contact National Distributors:

British Merchandising Pty. Ltd.
New South Wales.
49 York Street, Sydney

Audioson International Pty. Ltd.
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Queensland:
72 Wickham Street, Valley, Brisbane

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9 Osmond Terrace, Norwood, Adelaide

Victoria:
49 Westbank Terrace, Richmond, Melbourne

AO 51

looking for a medium the only question is . . .

Selecting a stereo amplifier in the medium price range poses only one major question . . . not which brand . . . but which model Sansui?

There's absolutely no doubt that dollar for dollar Sansui solid state stereo amplifiers offer more performance, more real power and greater reliability. So down to the nitty-gritty. *Which model Sansui?*

THE ALL-NEW SANSUI MODEL AU-505.

Now examine these abridged AU-505 specifications:

Power output:	*Music power — 90 watts at 4 ohms, 70 watts at 8 ohms*
	R.M.S. power — 70 watts at 4 ohms, 50 watts at 8 ohms
Frequency response:	*20-60,000 Hz. ± 2 dB.*
T.H.D.:	*Less than 0.5% at full rated output.*
Channel separation:	*Better than 50 dB.*
Input sensitivity:	*3 mV. (magnetic pickups), 4 mV. (microphone), 200 mV. (tuner, tape recorder, auxiliary).*
Dimensions:	*16" x 11" x 4 5/16"*
Price:	*$199* (recommended price).*

We confidently predict that the all-new Sansui AU-505 is destined to become one of the most popular stereo amplifiers ever available in Australia.

With almost double the power of the AU-101, the AU-505 represents terrific value at only $199 . . . and that's the *most* you will pay, for trading in your old equipment can reduce the price *considerably*.

Facilities on the new AU-505 offer great flexibility in tone control . . . provision is made for A-B speaker switching . . . a new flip-switch instantly provides tuner input . . . and both headphone and microphone jacks are situated on the front panel, together with a DIN tape recorder socket. Ask for complete specifications when you visit your franchised Bleakley Gray dealer!

***All Sansui models feature all-silicon transistor design**
***All output stages are semi-complementary Darlington SEPP-ITL OTL designs — no input or output transformers — consequently less distortion.**

ASK FOR FULL DETAILS. SEND THE COUPON RIGHT AWAY AND WE'LL SEND YOU ALL THE FACTS.

Bleakley Gray Corporation Pty. Limited,
28 Elizabeth Street, Melbourne, 3000
Telex: 31904
Please send me all the facts about the Sansui Model AU-101, AU-505, AU-555A* in detail . . . and the name of my nearest franchised dealer.

NAME .....

ADDRESS .....

..... POSTCODE .....

**Delete items not required*

Sansui

SANSUI — COMBINING TONAL QUALITY AND POWER.

priced amplifier? which Sansui?

THE PROVEN AND POPULAR SANSUI MODEL AU-101.

When reviewing the all low-noise silicon transistor AU-101 **"Electronics Australia"** said . . . *"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."* **"Electronics Today"** said . . . *"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" . . .*

Look at these abridged AU-101 specifications:

Power output:	*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*
Frequency response:	*20-60,000 Hz. ± 2 dB.*
T.H.D.:	*Less than 0.8% at full rated output.*
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:	*$149* (recommended price)*

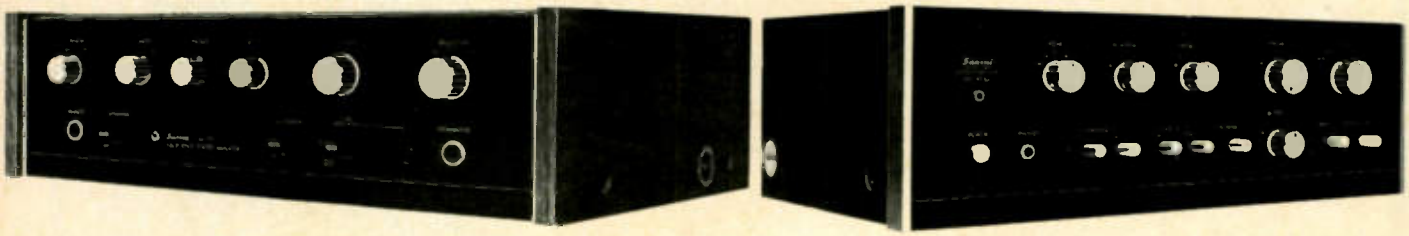
THE CHOICE OF THE ENTHUSIAST — THE SANSUI MODEL AU-555A.

Few amplifiers have received the acclaim afforded the Sansui AU-555A by the dedicated high fidelity enthusiast. All over Australia *(and the rest of the world)* the AU-555A has been selling in ever increasing volume. *What's the secret?*

Basically, **tonal quality.** Similarly priced competitors are left a long way behind . . . and some avid music lovers claim there's very little perceptible difference between the AU-555A and the top-of-the-line Sansui AU-999 in terms of tonal quality. *Of course, the AU-999 is a simply superb amplifier . . .*

Let's look at the abridged AU-555A specifications:

Power output:	*Music power — 85 watts at 4 ohms* *R.M.S. power — 66 watts at 4 ohms* *50 watts at 8 ohms* *60 watts at 8 ohms*
Frequency response:	*20-40,000 Hz. ± 1 dB.*
T.H.D.:	*Less than 0.5% at full rated output.*
Channel separation:	*Better than 60 dB.*
Input sensitivity:	*2 mV. (magnetic pickups), 180 mV. (tuner, tape recorder, auxiliary)*
Dimensions:	*15⅝" x 11 x 5⅜".*
Price:	*$237* (recommended price)*



PRICES. Prices quoted are recommended prices only . . . the actual cost can well be less. Trade-in valuations can make a world of difference! See your Bleakley Gray franchised dealer!

Sansui Distributors: Australia, excluding W.A.: **Bleakley Gray Corporation Pty. Limited.**

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, Fyswick, 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: *Atkins Carlyle 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.

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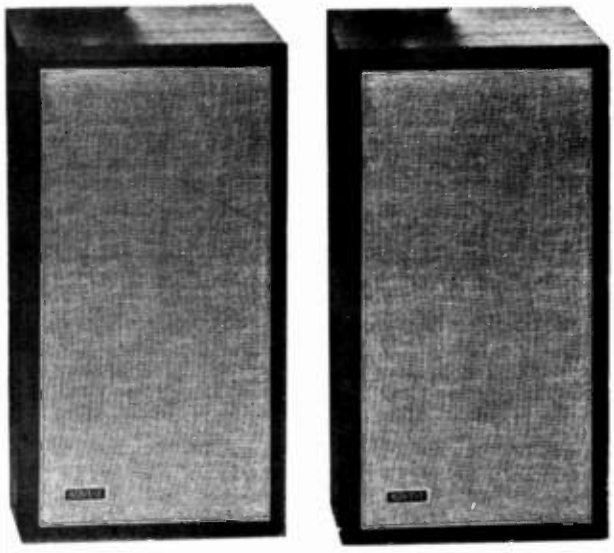

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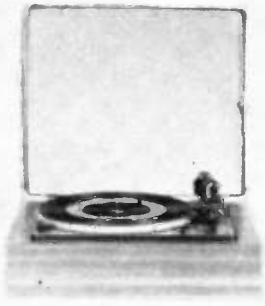
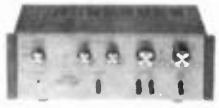
TEAC AG300 TUNER
Amplifier – 36 RMS per channel into 8 ohms – response 10-30,000 Hz

DUAL 1214 T/T
Complete – PLUS SHURE M55E Cartridge.



SPECIAL SYSTEM



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+ DUAL TURNTABLE *Complete with magnetic cartridge – diamond stylus.*

+ NIVICO BLA500 SPEAKERS → **$299**

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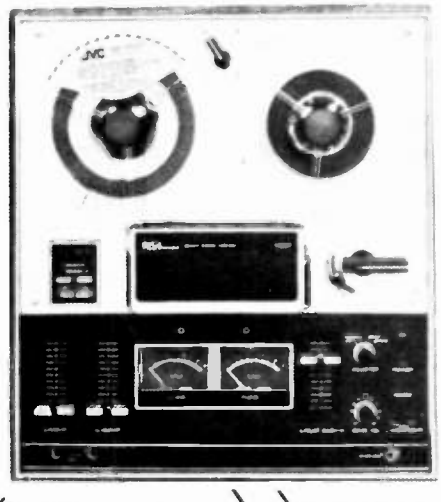

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- Source/MON Switch.

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INTRODUCING . . . A fine new amplifier from NIVICO

VN300

15 RMS per channel. Filters (Low. Hi) A + B Speakers – superior to all competitors. $160 List Price.

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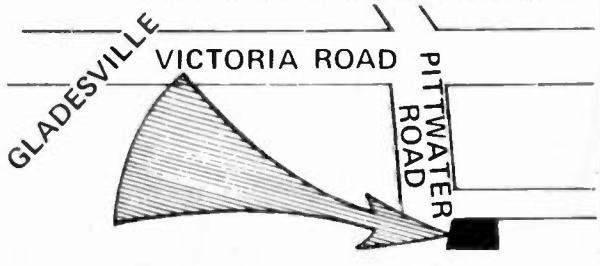
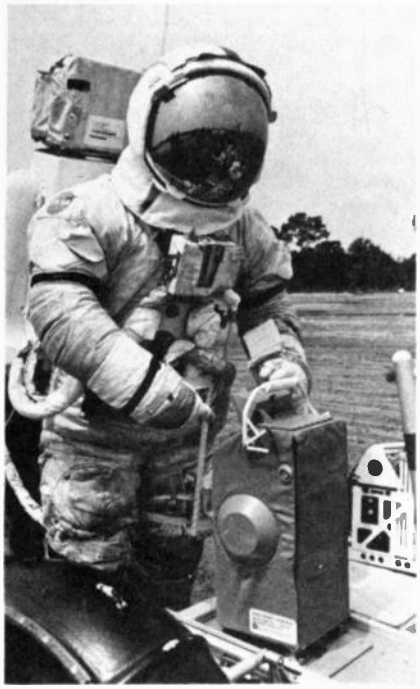


news digest

APOLLO 17



Apollo 17 commander Eugene A. Cernan prepares to remove a traverse gravimeter training mockup from Lunar Rover for deployment during extravehicular activity (EVA) training at the Kennedy Space Center. Apollo 17, with Cernan, command module pilot Ronald A. Evans and lunar module pilot Harrison H. "Jack" Schmitt, is scheduled for launch on the sixth U.S. manned lunar landing mission no earlier than December 6, 1972.

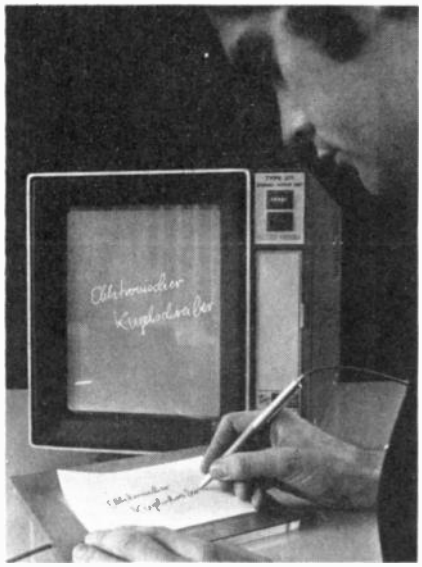
ELECTRONIC PEN FOR COMPUTER

A new input device for direct transmission of hand-written matter to a computer has been evolved in the Siemens' research laboratories at Munich.

By use of a special electronic "ball-point pen" and a thin piezo-ceramic plate as a writing base, drawings, sketches and handwriting can be passed directly to a computer as they are being written. The data can be transmitted over regular telephone lines for storage in the computer or to a display terminal.

The basic idea of the transmission method is to convert the position of the stylus continuously into electric signals and communicate them to the computer. An accurate image of the writing is obtained from evaluating the signal position by means of an electronic circuit linked to the plate and the pen. The pressure of the stylus on the writing pad does not, in itself, determine its position, but ultrasonic pulses with a pulse repetition frequency of 500 Hz are generated alternately at two edges of the writing pad, these edges being at right angles to each other. The acoustic pulses travel across the writing pad at a constant velocity, parallel to the edges from which they are emitted. Since the pulses apply slight pressure to the piezo-ceramic plate they create a voltage front which travels across the writing pad and is picked off capacitively by the stylus with a converted, common ball-point pen acting as a probe.

An electronic evaluator, connected to the piezo-ceramic sheet and to the stylus, forms signals from the propagation times of the acoustic pulses from the edge of the writing sheet to



the stylus. These signals, which represent the instantaneous position co-ordinates of the pen, can then be passed to a transmission line.

The system being developed by Siemens is simple and economical in comparison with other methods. The degree of accuracy in transmission of writing to the computer is very high. In the present experimental set-up the deviations remain under one per cent. Even minute distances of only 0.2 millimetres between two points or lines, and notes jotted down very quickly, are registered accurately. After scanning, the graphic information can be transmitted to the computer via telephone lines.

For researchers, however, this is but one step in the direction of more advanced techniques. Later on they hope that the computer will "learn" to process handwritten matter independently — for example, to read it and send it out in printed form.

news digest

modified by a bank of 16 electronic filters that are set to correspond with measured decibel figures for any window system. The resulting sound is what one would hear immediately behind the window area.

ELECTRIC VEHICLE SYMPOSIUM

Australia's first electric vehicles symposium 'Lead Power – Transport for the Seventies' is to be held in Sydney on September 26, Melbourne October 3 and Adelaide October 10, 1972. A later symposium is to be held in Townsville in April, 1973.

"Lead Power – Transport for the Seventies' will take a critical look at the present situation in battery electric vehicles – the performance, capability and economics of electrics; the range of vehicles actually available; what the future holds for electric cars and buses; future developments and the role of the lead traction battery.

Papers will be presented dealing with lead battery powered vehicles in personnel transportation, city delivery, golf cars (now used on eleven major Australian courses), the vast range of electric industrial trucks used in materials handling and other industrial applications, and electric cars and buses.

The symposium will provide a forum for those with an interest in any aspect of electric vehicles. Representatives of major electric vehicle manufacturers and traction battery suppliers, including overseas speakers will participate.

Preprinted texts of papers will be provided and a valuable range of published technical literature will be distributed to delegates. Much of the presentation will be in the form of panel discussions and open question periods.

Displays will include selected examples of technically advanced electric vehicles.

Invitations giving further information and registration forms are available from the convenors, Australian Lead Development Association, 95 Collins Street, Melbourne, Victoria 3000. No charge is made for registration. ●

Sizzling!

the only word to describe the extraordinary performance of the new Wharfedale "Denton" and "Linton" compact speaker systems.

Building effective compact speaker systems requires technical "*know-how*" and *experience* — and that's where Wharfedale really shines. For over forty years Wharfedale has been Britain's leading manufacturer of high quality wide range loudspeakers; Wharfedale advances in technology are very obvious in the all-new "Denton" and "Linton".

Two models of each unit are available . . . a two way system with an entirely new 8" bass reproducer and a 2" tweeter, and a three way system which specifies a 4" mid-range speaker in addition, to add further reinforcement in the "*presence*" frequencies.

A long throw voice coil is used in the bass speaker to provide restraint-free lower registers and the new 2" tweeter is the result of intensive Wharfedale research — high frequencies are smooth and satisfying. Large magnet structures offer greater sensitivity.

Now examine closely these brief specifications:

DENTON 2.
Size: 14" x 9¾" x 8¾"./Frequency response: 60-16,000 Hz. ± 3 dB./Power rating: 20 watts DIN./Speaker complement: 8" bass speaker, 2" tweeter./Crossover frequency: 1,400 Hz./Finish: Oiled teak or polished walnut.

LINTON 2.
Size: 19" x 10" x 9½"./Frequency response: 55-17,000 Hz. ± 3 dB./Power rating: 20 watts DIN./Speaker complement: 8" bass, 2" tweeter./Crossover frequency: 1,200 Hz./Finish: Oiled teak or polished walnut.

LINTON 3.
Size: 19" x 10" x 9½"./Frequency response: 55-17,000 Hz. ± 3 dB./Power rating: 25 watts DIN./Speaker complement: 8" bass, 4" mid-range, 2" tweeter./Crossover frequencies: 1,100 and 4,000 Hz./Finish: Oiled teak or polished walnut.

DENTON 3.
Size: 14" x 9¾" x 8¾"./Frequency response: 65-17,000 Hz. ± 3 dB./Power rating: 25 watts DIN./Speaker complement: 8" bass, 4" mid-range, 2" tweeter./Crossover frequencies: 1,100 and 4,000 Hz./Finish: Oiled teak or polished walnut.

WHARFEDALE WHARFEDALE ***FINEST BRITISH DESIGN.***

Come and hear the difference Wharfedale experience makes. Call at your nearest franchised Bleakley Gray dealer — ask for a no-obligation demonstration. Imagine how well they'll sound at home . . . *then find out how little they cost!*

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SG-WNP-4

PORTABLE SOUND SYSTEMS

ABOVE: Oidgeridoo, vocalist and electric guitar! (Johnny Ashcroft and his group).

LEFT: Mark Farner of Grand Funk Railroad – photos courtesy E.M.I.

HOW TO ACHIEVE OPTIMUM RESULTS

by Donald L. Potter,
Senior Development Engineer,
Shure Brothers Inc.

Ironically perhaps, the quality of sound obtainable from home hi-fi systems is often far better than that achieved at most live performances, for modern recordings are produced under practically ideal conditions — free from such problems as acoustic feedback, background noise, and halls with poor acoustics. By comparison a live performance provides a real challenge to both performers and soundman. Since an audience judges a performance by the quality of sound, it is obvious that a good sound system is absolutely essential to a good performance. But even with the best available equipment, its improper use can give results that are catastrophic.

THE basic sound system consists of one or more microphones, microphone cables, a mixer/amplifier, speakers, and speaker cables.

A low-impedance directional microphone of rugged construction is recommended. Low-impedance microphones (50-250 ohms) are required to permit the use of long cables to the mixer/amplifier.

High-impedance microphones (10,000-50,000 ohms) are limited to only about 20 feet of cable because they are subject to a high-frequency roll-off, or loss of high-frequency signals in the cable. For example, consider a 30,000-ohm microphone connected to a 20-foot cable whose capacitance is 26 pF per foot. With this combination, the microphone output is attenuated by 3 dB at at 10 kHz. With the same cable capacitance, but using a 150-ohm microphone, 4000 feet of cable would be required to produce the same high-frequency loss.

High-impedance microphones may be used if the mixer/amplifier is to be located on stage. This may be the case with a small group where one of the performers doubles as the soundman. Since the microphones are located close to the mixer/amplifier, 20-foot cables may be long enough.

High-impedance microphone cables are susceptible to hum pickup from stage lights and other ac-line-operated devices, and care should be taken in locating them. The use of low-impedance microphones and cables generally eliminates this problem.

The use of low-impedance microphones and long microphone cables permits the mixer/amplifier and the soundman to be located off-stage and, preferably, in the audience area. This is the only way he can hear the performance exactly as the audience does.

Microphones are available with a number of different popular characteristics. The polar characteristic is a chart or graph of how well the microphone picks up sound from the front *versus* the sides or the back.

There are two types of microphones in general use today. One is the *omnidirectional* microphone, which picks up sound equally well from all around. The other is the *unidirectional,* sometimes referred to as the *cardoid* microphone, which picks up sounds with maximum sensitivity from the front, has slightly reduced sensitivity from the sides, and rejects sounds from the rear. Of these two types, the unidirectional model is preferred for two reasons. Firstly, the microphone is less prone to feedback because the back of the microphone can be pointed towards speakers or reflecting surfaces. Secondly, the microphone is sensitive to the performer and less sensitive to the audience background noises or other instrumental sounds that are coming from the sides or back of the microphone.

When selecting a unidirectional microphone, it is desirable to consider whether or not a microphone with *proximity effect* is wanted. Proximity effect is the increase in low-frequency response as the microphone is moved closer to the performer's lips.

Microphones with proximity effect increase bass output as the microphone is brought closer to the performer's mouth. This allows the performer a great degree of control over the sound and the response by moving the microphone closer or farther away. This change in low-frequency response is desirable in many cases so that a performer can move close to the microphone and produce a deep, resonant sound when doing very soft, intimate work, and move away when this effect is not wanted. The proximity effect also aids the younger performer — giving a more resonant, mature sound to the voice. However, a few performers, prefer a microphone without proximity effect. The choice is up to the individual.

It is important to choose a microphone that has the same frequency response from the front and sides. This feature allows the performer to turn the microphone off-axis without changing the sound quality. The only effect that should be

Close-mike technique. This reduces acoustic feedback and increases bass output with microphones having proximity effect.

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noted is slightly reduced sensitivity.

One more consideration in choosing a microphone is the windscreen or "pop"-filter over the end of the microphone. Microphones that are used for close work by performing vocalists should have an extremely good "pop"-filter. The "pop"-filter is designed to cut down the wind or "pop" blast that comes when a "P" or other explosive-type sound is made. If you hold your hand a few inches from your mouth and make a "P" sound, a blast of air can be felt on your hand. The microphone also feels this blast of air and this creates a "popping" sound. Microphones equipped with a blast or "pop"-filter reduce or attenuate this effect. This blast sound, if not attenuated, may cause preamplifiers to overload or distort and produce an objectionable sound in the speaker system.

MICROPHONE PHASING AND CABLES

The importance of the cable that is connected to the microphone should not be overlooked. Good cables and periodic cable maintenance ensure reliability.

It is recommended that microphone cables be wired with three-pin male and female *Cannon*-type connectors. This type of connector has proven to be rugged and reliable and requires little maintenance. The end of the cable that connects to the microphone should be wired with a female connector and the amplifier end with a male connector. By so doing, every cable can be used as a microphone cable or as an extension microphone cable.

The three-pin *Cannon*-type connector is designed so that pin No. 1 connects first as two mating connectors are joined together. Pin No. 1 is used as the shield or ground and therefore the shield is connected first. Because of this design feature, microphones or microphone cables may be connected to live amplifier inputs during a setup or performance without the annoying buzzes, clicks, or pops that are normally associated with open grounds. Pins 2 and 3 of the connector are wired to the two balanced conductors of the microphone cable. Consistency is important when wiring connectors to mike cables to ensure compatibility and proper phase.

To test two microphones and/or their cables for proper phasing connect them to an amplifier and then talk or sing into the two microphones while holding them three or four inches apart. The sound from the speakers should be the same when talking into either microphone or directly between them if they are in-phase with each other. If the sound drops drastically, or a dead spot is found when talking between the two microphones, one of them (or its cable) is out-of-phase.

To change the phase of the one microphone or cable, interchange the wires that are connected to pins 2 and 3 of the connector. All cables and microphones should be tested in this manner to ensure that they are in-phase with each other. If a microphone is of different phase than other microphones, refer to the manufacturer's instructions on how to change the phase of that microphone. Some microphones are designed so that phasing changes are made by removing the male plug element in the microphone. In others, this element is cemented in place, forming a seal for the microphone to provide proper low-frequency response; removing the plug element in this type of microphone may alter or seriously affect the microphone's performance.

It should be noted that when performers are hand-holding microphones and singing and dancing with them, the cable is subjected to severe twisting, bending, or stretching. This will eventually cause the shielding inside the cable to break into small pieces, reducing its effectiveness. Continuity of the shield may be tested with an ohmmeter. A good shield should measure no more than a few ohms. A poor shield or one that has been broken inside the cable will measure in hundreds or even thousands of ohms, and twisting or bending the cable will cause the ohmmeter reading to change. Cables in this condition should be replaced. Only high-quality, low-capacitance, two-conductor shielded cable should be used for microphone cables.

A very convenient method of running a number of microphone lines between the mixer/amplifier and the stage or performance area is to use a multiple-pair cable or a number of single cables bundled together. There are quite a few multiple-pair cables available which may be used for this purpose. It is suggested that each end of this cable be terminated in a junction box. Such an arrangement will reduce setup time significantly and is generally much neater than running many separate cables from the stage to the mixer. Each microphone cable should be connected to a separate mixer/amplifier input channel.

Separate microphones for each vocalist enable soundman to blend the voices for optimum mix.

MICROPHONE TECHNIQUE

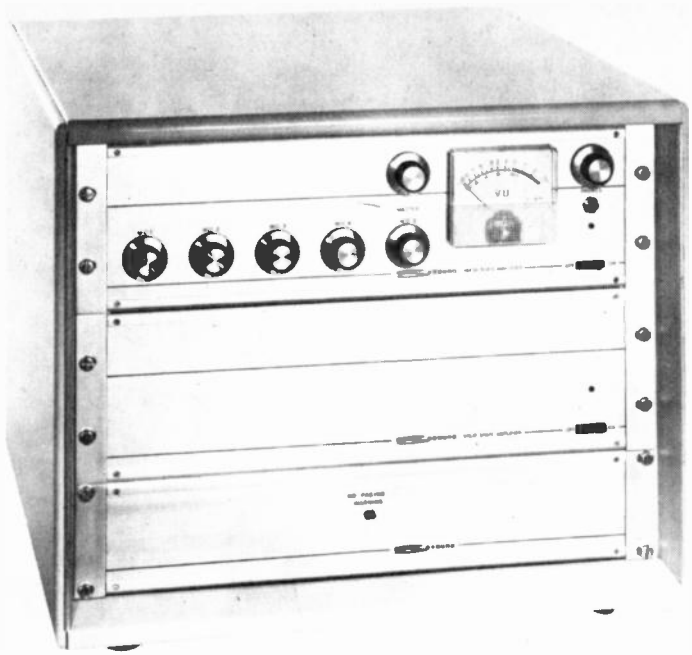
Microphone technique is extremely important in obtaining a good live performance. For example a performer who holds a microphone at arm's length while singing in front of a band cannot expect to be heard over the instruments. The soundman will try to compensate for this poor technique by turning up the volume control until acoustic feedback is produced. Generally one of two things happens under these conditons. Either the sound of the orchestra entering the vocalist's microphone will drown out the vocalist, or the sound system's acoustic gain will be limited by feedback. To avoid these problems, the vocalist should work the microphone at a distance of one to three inches from his mouth.

By varying the distance between the microphone and his lips, it is possible to use the microphone as a very effective volume control. For soft, intimate work the microphone should be used very close. For extremely loud passages the microphone should be backed off to a distance of several inches. By backing off the microphone in this way the performer helps to avoid overloading the microphone preamplifier on extremely loud passages.

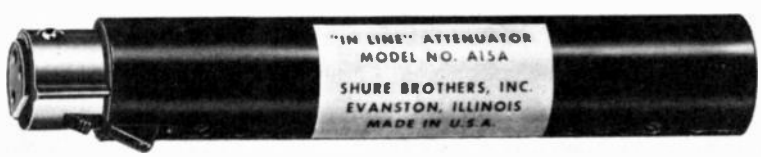
Some performers create "popping" sounds when working close to the microphone. This effect may be reduced by holding the microphone slightly below chin level.

Normally, it is not necessary to "mike" the instruments. However, it may be desirable to "mike" a piano or wood wind, such as the flute. In "miking" a piano it is sometimes necessary to put the microphone inside the piano over the strings and partially close the top to avoid acoustic feedback. As an alternative, the microphone may be placed behind (on an upright) or underneath (on a grand) the sounding board. The flute or similar acoustic instruments may be picked up very effectively by playing it very close to an unused vocal microphone.

Acoustic feedback often dictates general microphone placement. But also to be considered is the rejection of unwanted loud instruments, such as drums. In the case of "miking" a flute, it may be necessary to point the back of the unidirectional microphone towards the drums in order to maintain a high signal (flute) to noise (drum) ratio.



Solid state amplifier from Seeburg has individual level adjustments (plus master control) on each of five separate input channels.



This balanced and symmetrical in-line microphone attenuator has a 15dB loss.

Low impedance microphone matching transformer.

SELECTING MIXER/AMPLIFIERS

When choosing a mixer/amplifier (which may be a single integrated unit or two separate units), a number of specifications and features should be considered. These include input impedance, input clipping level, number of input channels, individual tone controls, built-in reverberation, feedback filters, and power vs speaker load impedance.

The mixer/amplifier microphone inputs should be wired or connected for low-impedance microphones. If the mixer/amplifier does not have provision for low-impedance microphones, but is only wired for high-impedance types, an accessory impedance-matching transformer may be added to the input jacks to convert them to low impedance.

It is important to be aware of the microphone preamplifier input clipping level. If clipping or distortion occurs in the microphone preamplifier, this distortion will be heard in the speakers, regardless of the settings of the tone or volume controls on the mixer/amplifier. It is interesting to note that performers, when working very close to the microphone, such as with hard-rock or acid-rock program material, may produce signals in excess of the clipping level of the preamplifier. In this instance, an input attenuator will generally eliminate the distortion that would otherwise occur. Some amplifiers have an input attenuator switch built in. For those amplifiers without this feature, an

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This microphone has ball type 'pop' filter and is characterized by proximity effect.

in-line attenuator may be connected in the microphone cable. Some vocalists are capable of producing sound-pressure levels of approximately 130 dB SPL, at the microphone diaphragm, 10 dB above the threshold of pain! This would correspond to approximately 1/10th of a volt output from a low-impedance microphone. This is a case where an input attenuator would certainly be invaluable.

If there is more than one vocalist, it is desirable to have a separate microphone for each performer and a mixer/amplifier with enough inputs and controls to allow individual adjustment of each mike for proper balance.

Adjustment of the individual-channel-volume controls, tone controls and master volume control — commonly referred to as "mixing" — is done by ear. Two possible situations exist which could cause problems First, if individual volume controls are adjusted too low and the master control is set too high, output from the speakers may contain an excessive amount of hiss and noise. On the other hand, if the individual volume controls are too high and the master volume control is too low, the mixing stages ahead of the master volume control may distort and produce premature clipping thus limiting the overall output power of the amplifier with the result that full power is not obtainable. It is best to follow the amplifier manufacturer's instructions as to how to set up the volume controls. In the absence of such instructions, an audio-signal generator connected to an input channel and an oscilloscope monitoring the speaker output may be used to determine minimum volume control settings at which the power amplifier is still capable of producing full output without mixer or preamplifier clipping distortion.

It is desirable to have separate tone controls on each input channel. This permits individual tone shaping of each voice to "brighten" a flat-sounding voice or "mellow" a nasal-sounding one.

Built-in reverberation is another feature to be considered. Since much of the modern music today uses artificial reverberation, both the entertainer and the audience expect this effect in a live concert. Two types of reverberation systems lend themselves to portable sound-system use. They are the tape-loop and the coil-spring reverberation devices. The coil-spring devices are popular due to their more natural sound when reproducing the voice, and freedom from the mechanical problems and frequent maintenance associated with tape-loop devices.

A number of the newer mixer/amplifiers incorporate feedback or frequency-equalizing filters that are useful in maximizing acoustic gain and minimizing acoustic feedback. While these filters are useful when the system is operated at or near the threshold of feedback, they are often misused. Feedback filters generally employ selective-frequency filtering that produces a notch or dip in frequency response over a limited frequency band with a filter depth of between 3 and 10 dB at the centre frequency. These filters, when properly used, can compensate for peaks in the acoustic response of a sound system in a particular room without seriously affecting the sound. But indiscriminate use of the filters, such as turning on all the filters, can produce a frequency response with more peaks in the response than with all the filters out and may seriously affect the sound.

Proper use of filters will provide maximum acoustic gain with no apparent change in over-all sound quality. The filters are adjusted by increasing the gain until feedback is noted and the one filter that will eliminate that feedback mode is activated. Generally the first feedback pitch noted is a low-frequency one and activating the low-frequency filter may remove too much of the bass response of the overall sound. To compensate for this lack of bass, increasing the amplifier bass controls will restore normal sound quality. Alternating back and forth between the feedback-filter adjustments and the tone controls, and increasing the volume control until feedback is again noted, a point will be reached at which two or more feedback frequencies are present at the same time. This is generally the optimum adjustment position for the tone controls and feedback filters. It should be noted that changes in location or orientation of the microphones or loudspeakers can produce drastic changes in feedback thresholds for different frequencies. It may be possible to gain additional feedback margin by repositioning the speakers and/or the microphones. After this is done, the feedback filters and tone controls

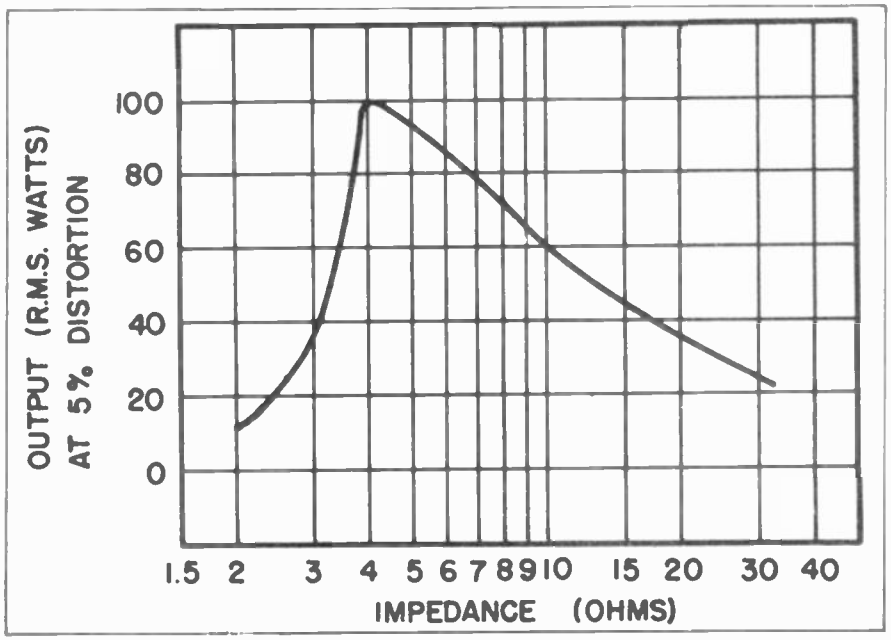

Fig. 1. Available output power of typical amplifier for various loudspeaker loads. This particular unit has been optimized for a 4-ohm speaker load. Other impedance values reduce available output power. Where mismatch is unavoidable, always pick higher rather than a lower impedance.

should be readjusted for an optimum setting.

It is very important to check the impedance of the speaker load that is to be used with the power amplifier. If this point is disregarded, it is very likely that maximum output power from the amplifier will not be obtained and damage to either the speakers or amplifier, or both, may possibly occur.

For example, take the case of an all-transistor 100-watt amplifier without an output transformer, designed to operate into a 4-ohm speaker load. This amplifier, when loaded with 4 ohms, will produce 100 watts When an amplifier is operated with its rated speaker load, it is generally operating at its maximum voltage and current output; this results in maximum power output. If this same amplifier is operated at a higher impedance load, for example 8 ohms, the available output voltage is the same, but less output current is required and the amplifier might typically produce only 60 or possibly 70 watts. If it were connected to a 2-ohm speaker load, the amplifier would operate at its maximum current capabilities trying to drive the 2 ohm load but would not be able to reach maximum voltage conditions. Again, output power would be limited. In this case it may produce only 10 or 20 watts (Fig. 1.)

Some amplifiers are not protected against low-impedance or short-circuited speaker loads. Such components may be damaged if operated at speaker loads less than those specified by the manufacturer. Generally, when an amplifier is operated at a lower impedance load than that recommended by the manufacturer. it will tend to overheat and may damage some of the transistors. Some amplifiers incorporate thermal switches to avoid such damage due to overheating. When the speaker load cannot be exactly matched to the recommended amplifier loading, it is generally better to use a speaker load impedance that is somewhat higher than recommended rather than one that is lower. Operating an amplifier in this way sacrifices less power (see Fig. 1) and increases reliability.

Some solid-state amplifiers employ voltage and current-protection circuitry. This type of amplifier, while capable of producing tremendous amounts of output power to a resistive load, may not deliver the same amount of power to a highly inductive speaker load such as may be encountered with 15-inch heavy-duty cone-type speakers. Under these conditions the amplifier may "current-limit", producing a triangular-shaped output rather than flat-top clipping which is normally associated with output distortion. If this happens, the speaker load impedance should be increased by reconnecting the individual speakers in a different impedance configuration.

SPEAKER PHASING AND CABLES

Speaker and speaker-cable phasing is usually more important than microphone phasing. Proper phasing of speakers and speaker cables will insure that all speakers will work together rather than canceling out each other's efforts. Each individual speaker in a speaker cabinet or enclosure should be checked for proper phasing with every other speaker in that cabinet. A simple method for checking the phasing of loudspeakers is to connect a 1½-volt flashlight battery between the speaker cabinet terminals and noting the direction in which the speaker cones move. All cones should move in the same direction, either towards or away from the grille cloth. All speaker systems or assemblies and speaker cables should also be checked for proper phasing.

If more than one type of power amplifier is being used to drive the different speakers, it is important to check the phasing of the overall power-amplifier/speaker system. Depending on the number of transistors in the amplifier, phasing from the input terminals to the speaker terminals may be different for different power amplifiers. The simplest way of checking the entire speaker/power-amplifier system is to play program material, preferably with low-frequency content, or have someone talk into a microphone while another person walks through the listening or audience area, checking for dead spots between the various speaker cabinets. Should a dead zone be found, simply reverse the speaker wires at the power amplifier to change

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the phasing until all the speakers are in-phase.

SELECTION OF SPEAKERS

Sound-reinforcement speaker systems may be divided into two basic types; these are called the "distributed speaker system" and the "source-oriented speaker system."

The distributed speaker system utilizes a large number of loudspeakers mounted at equidistant intervals over a large area – usually in the ceiling. Generally speaking, these speakers may be of low-power-handling capability since each individual loudspeaker is required to cover a relatively small area. The major advantage of this type of system is that it provides very uniform sound intensity over virtually any area and is ideally suited for paging and background music in such locations as airports, restaurants, hotel lobbies, and industrial plants. All of these applications require uniform coverage over large areas at relatively low levels of sound intensity. Of greatest significance, however, is the fact that these installations do not require that the listener be able to see the sound source for it to function as a good sound-reinforcement system.

A speaker system for any of the performing arts must be source-oriented to give the listener the illusion that all sound is coming directly from the actual source. Two basic speaker systems are in general use for providing source-oriented sound: one system employs both high-and low-frequency horns, the other employs speaker columns or line radiators.

The horn-speaker approach usually employs two drivers, one for low frequencies and another for higher frequencies. The single-horn low-frequency speaker exhibits a directional characteristic that becomes less defined at low frequencies. Quite often, this nondirectional pattern will lead to low-frequency acoustic feedback. Also, as the pattern becomes less directional, the total radiated energy on the listening axis of the speaker is decreased.

High-frequency horn-driver combinations can be made to have very uniform directional characteristics with respect to frequency. When used in conjunction with the low-frequency horns, a full-range system is obtained. Due to the non-directional character at low frequencies, such a system will have an imbalance of low- to high-frequency directional characteristics. For example, when the low-frequency device is reproducing a low-frequency tone as an omnidirectional source, the on-axis intensity is low. At the same time the high-frequency device may be operating and its on-axis intensity is high. The result will be a very "metallic" sound, exhibiting a lack of low-frequency content. Increasing the amplifier bass controls to balance the sound may cause low-frequency feedback.

The high efficiency of this type of speaker system is its major advantage over most column speaker systems, although this difference is rapidly disappearing as better column speakers are developed.

The column speaker or line-radiator offers a number of significant advantages over the other types of speaker systems where source-oriented sound is required. The column speaker can offer high-quality reproduction at modest cost; columns are generally small, compact, and light in weight, which minimizes mounting problems and provides considerable flexibility in their placement. Narrow vertical distribution and wide horizontal distribution are characteristics of a column, which make it such an

(Continued on page 78)

The 'small' centre speaker enables the entertainer to hear herself. It also provides sound fill for the first four rows of the audience. The column speakers located at the sides of the stage provide source-oriented sound covering entire auditorium.

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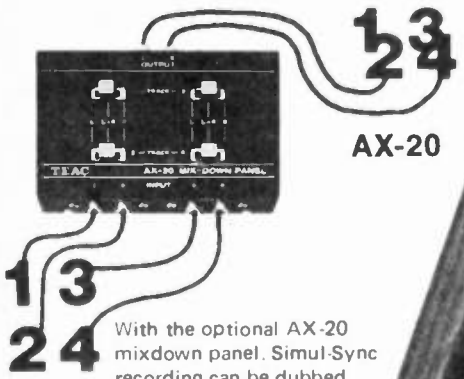

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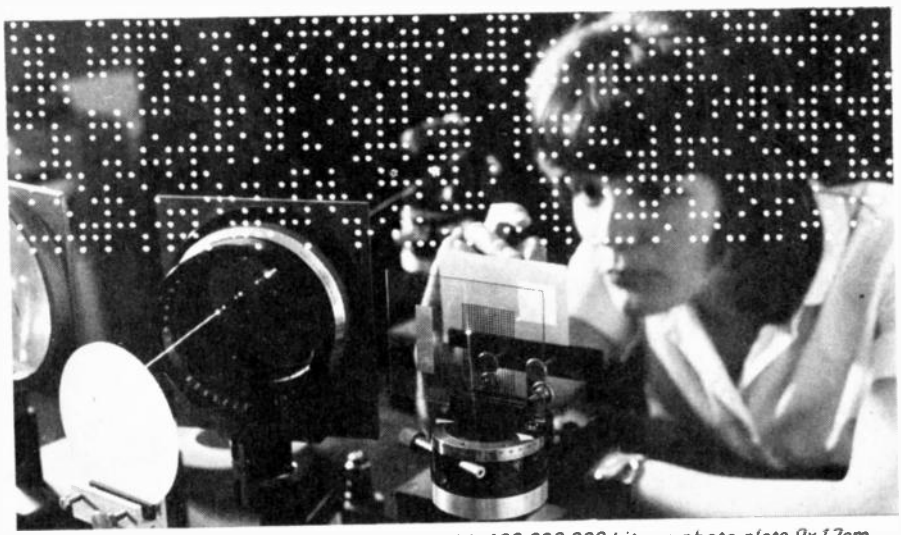
THE LASER HOLOGRAPHIC MEMORY



Laser data storage model from Siemens holds 100,000,000 bits on photo-plate 9x12cm.

Storage density of this laser holographic memory is 100,000 bits/ mm²

MORE than two decades ago, scientists began to experiment with basic types of holograms. Trial holograms were produced by electron beams and other means, but no practical applications were developed. Since the actual meaning of "hologram" is "complete writing," the word has continued to be widely used for a number of subsequent and related processes.

HOLOGRAPHY POTENTIAL RECOGNISED

Hitachi became interested in holography, the technology involving the production of holograms, in 1967 when the company's Central Research Laboratory commenced preliminary research into practical uses for this potentially comprehensive type of "memory" utilizing laser beams as the light source. As many as 50 engineers were organized to work on the project.

Two years ago, a team of four men began intense work on an improved type of laser holographic memory which would have a larger capacity, greater stability and far more significant applications than any hologram developed to date.

DEFINING THE TEAM'S TASK

Since laser beams are inherently stable sources of monochromatic optical frequency waves and are able to form sharply directed beams parallel to within a small fraction of a degree, it was determined some years ago that the laser should serve as the light source for the ambitious holography program. Still, the problem of how to properly disperse the laser beam onto the information plate remained to be solved.

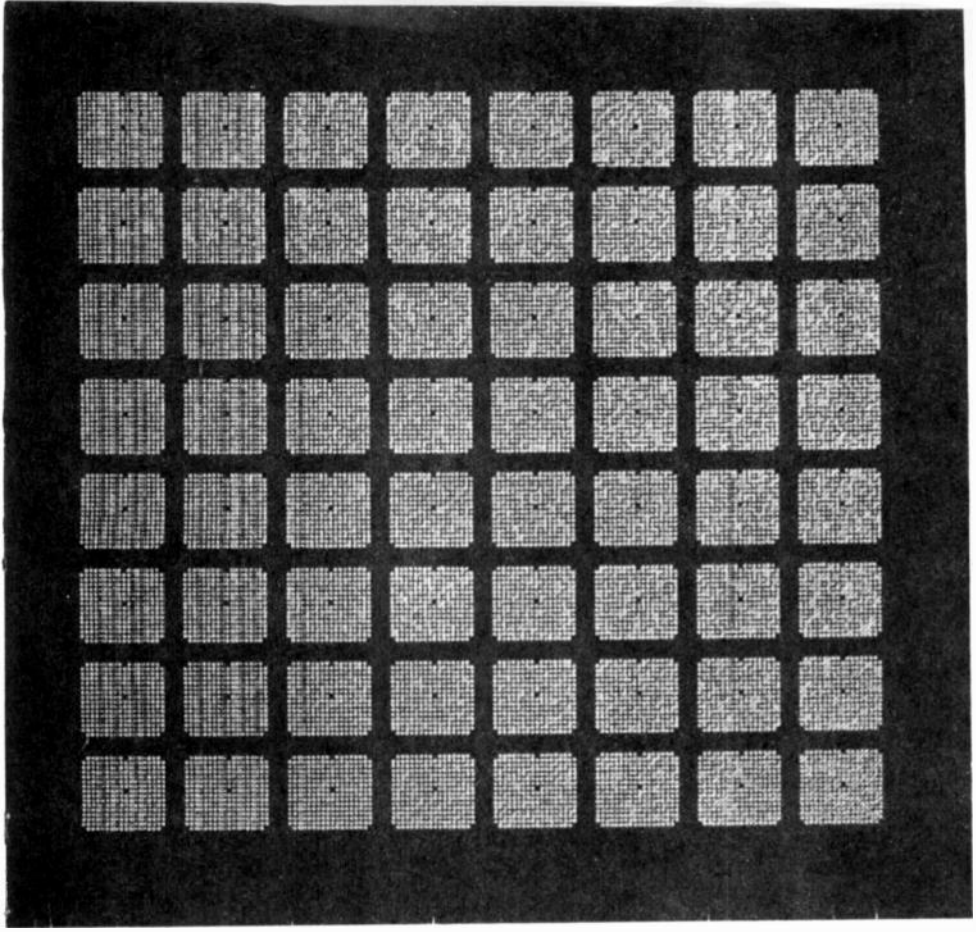
The Hitachi team's task was therefore well defined: a device was needed which would evenly diffuse the beams onto the plate, increase the density, or capacity of information, and permit all types of information to be accepted.

DISCOVERING THE PERFECT FORMULA

By early 1971, after innumerable computer calculations and laboratory experiments with various types of diffusion coatings, the Hitachi team succeeded in developing an optical plate which they called a Random Phase Shifter (RPS). The new device not only met their expectations, but proved to have ten times the density of the most advanced existing model. In appearance, the RPS looks like an ordinary glass plate, but when viewed at an angle which permits prismatic reflection to occur, a multi-hued random pattern can be seen. It is made of numerous thin layers of cerium oxide which are evaporated by vacuum deposition onto the glass substratum through several kinds of random-patterned screens. The correct patterns were arrived at through repeated experiments with a random number table.

INCORPORATING THE RPS

The pure laser beams pass through a lens onto the RPS where they are "routed" to the information plate. After the diffused beams go through the plate, they are called "information-bearing beams" and are then directed to the specially-treated transparent gelatin film for recording of the information. An astounding 20,000 bits of digital information, or 2,500 characters, may be stored in a circular space only one-half millimeter in diameter using this system. Capacity has been limited in previous laser holographic memories to around 10,000 bits per square millimeter because noises usually appeared as the



information-bearing laser beams were concentrated in a specific area.

As depicted graphically below, another way of expressing the worth of the laser holographic system is to say that the RPS eliminates unwanted "fringes" among the information beams and creates clearer interference, or information patterns. The RPS therefore permits both the density and quality of the memory recording to be vastly increased.

The type of laser employed in this project is the powerful, blue-green Argon Ion Gas Laser (Ar ION).

STABLE, FAST AND LESS EXPENSIVE

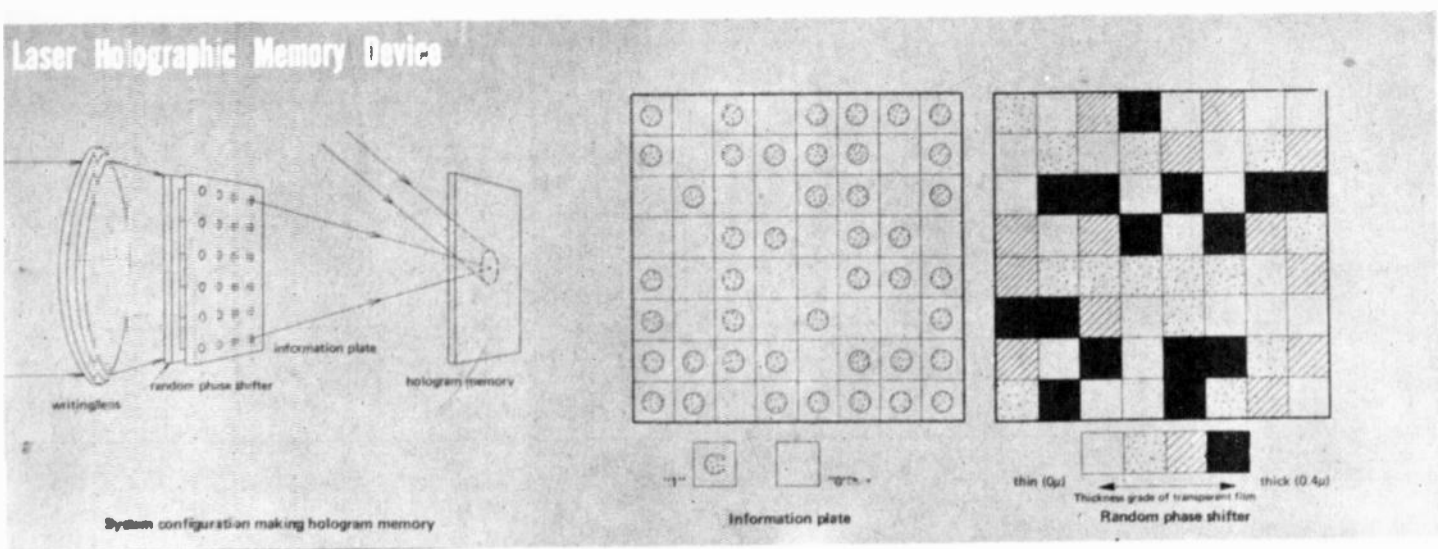
Another feature of the laser holographic memory is its "redundancy" or high stability. Although the film is incredibly small, the information is not lost if the film is accidentally scratched, unlike many other types of memory systems. Also, the readout speed of the memory is 10,000 to 100,000 times that of disc memories. By throwing a laser beam on the memory, 20,000 bits can be read in only one microsecond.

If applied to a computer system the laser holographic memory could greatly lower production and usage costs, as well as speed up functions, as it is much less expensive than either LSI or core memories.

APPLYING THE TECHNOLOGY

Although the memory may not be ready for practical applications for perhaps three to five years due to other technicalities which must be resolved, the scope of the laser holographic memory is broad. Four basic types of usage are foreseen at this time: High speed computers, as mentioned above, could utilize the minute memory system. A total of 10,000 holographic memories, laid on a 5 cm^2 plate, would have a total storage capacity of 200 million bits and a read-out speed of only a few microseconds. Information retrieval systems – actually any system which stores information and gives answers to questions fed into the system – could benefit from it, also. In addition, such seemingly unrelated and diverse fields as audio-visual equipment – three-dimensional movies and VTR cassettes – and recognition systems (such as for recording and identifying fingerprints) could utilize the laser holographic memory system.

The laser holographic memory may well usher in a new era of super-miniaturized memory systems which will certainly be needed to keep pace with the flood of information produced by the present and future generations. ●



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SONAB MODEL 85S TURNTABLE

This Swedish designed turntable is built under licence in Japan.

AS with the Sonab speakers — reviewed in our May issue — the Sonab turntable is unusual both in appearance and design philosophy. But unlike the speakers, the turntable is built under licence, by Yamaha in Japan.

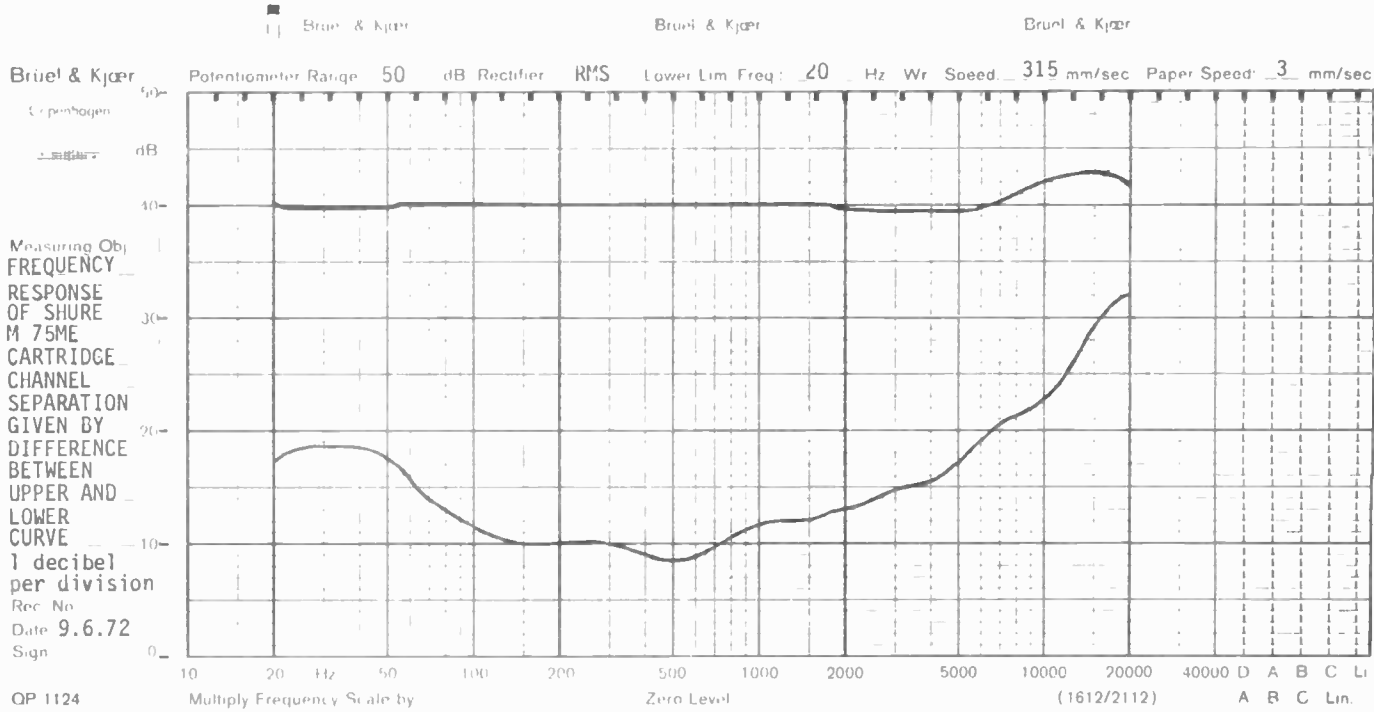
Once unpacked from its moulded polystyrene foam packaging, one immediately notices the lack of trimmings and fancy controls so evident on many turntables now on the market. Apart from the chromed tone arm, the metal disc in the centre of the black rubber turntable mat, and the visible edge of the cast aluminium alloy turntable, the complete plinth is finished in black.

The top of the base consists of a single diecast panel. This supports the spring-isolated motor, spring-isolated tone arm, and turntable mounting panel with its associated automatic cueing controls.

A clear perspex cover with a small Sonab label glued in the centre is attached to the base with friction type hinges. These hinges effectively dampen the closing of the lid. There is an audible knock when the lid comes in contact with the base but not to the extent that the arm is lifted from the records.

The two main controls are recessed rocker switches, one on each side of the top panel at the front. The one on the left hand side is for 45 r.p.m. or 33-1/3 r.p.m. speed selection whilst the one on the right is used for starting the player or rejecting a record in the middle of play. The only other control is an unusual shaped cueing lever which is confusingly labelled and difficult to use because of its direct unclamped linkage. In fact, after two weeks of operation the bent cueing lever still had us confused, resulting in a couple of scratched records.

The automatic controls on this turntable were possibly the quietest and smoothest operating that we have seen. A quick look under the precision cast aluminium turntable explained why it was so quiet; most of the



components are moulded from nylon. Operation of the automatic controls is simple and effective. To play a record it is necessary only to place the record on the turntable, move the tone arm over the record edge, and press the play switch. Once the switch is pressed, the turntable starts rotating, and the arm is lowered automatically on to the record. At the end of the record the arm is automatically lifted and returned to the rest, after which the motor stops. The automatic return and shut off can be initiated at any time during the playing of a record by pressing the play switch.

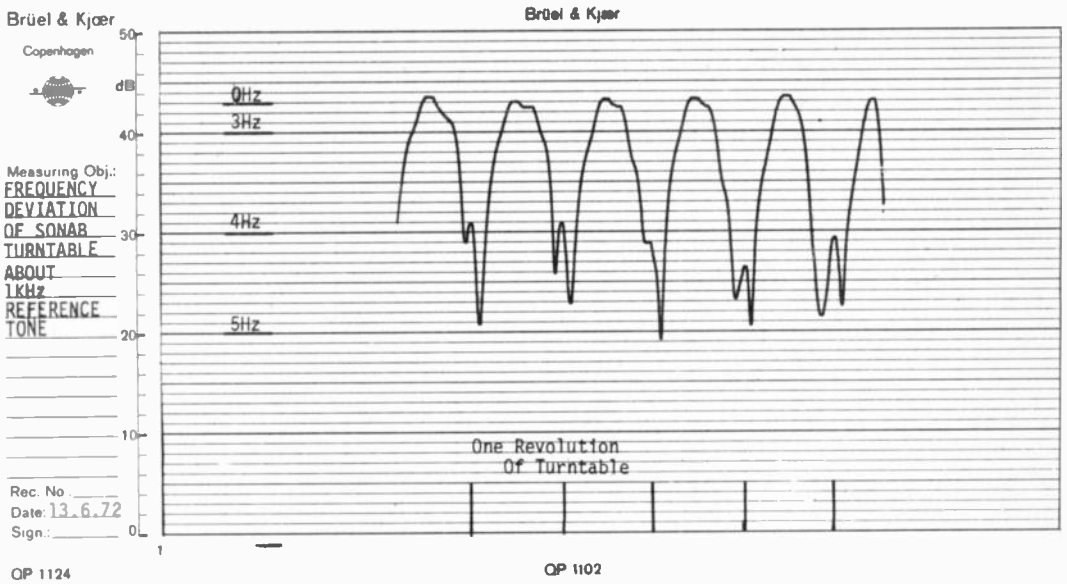
TONE ARM PIVOT

The tone arm pivot arrangement is another unusual feature of this turntable. Whereas most conventional tone arms have the axis of the horizontal bearings in the same plane as the tone arm axis, and externally visible, the Sonab has completely the opposite. The bearings are located inside the tone arm pedestal and approximately ¾ of an inch below the tone arm axis. This results in a clean and uncluttered external appearance but produces complex out of balance moments. This problem is adequately corrected by a cantilevered mass fixed to the tone arm pedestal underneath the turntable, minimising the moments produced in the vertical plane. The only resultant error is that produced by the imbalance necessary to obtain the desired tracking weight. However, this makes it impractical and very unwise to change the cartridge type or brand, unless it has the same weight as the one installed, as any change in cartridge weight would necessitate adjustment of the cantilevered mass, so that the resultant reaction is through the horizontal bearings. However as the Shure M 75 ME cartridge supplied with the turntable has above average performance, few people are likely to make any change.

The frequency response of the cartridge was one of the flatest we have seen, being within ½dB from 20Hz to 7kHz and rising 3dB at 15kHz. This small rise at the top end was undetectable. Channel separation was exceptional, being as much as 31.5dB at 500Hz and only dropping below 20dB above 10kHz (and this possibly being due to excessive antiskating force). The tone arm is balanced and the tracking weight set by screwing a chrome counter weight in or out to obtain balance, and then moving it a calibrated distance to produce the desired tracking weight. The antiskate mechanism is factory preset and presumably not adjustable – apart from a screw located under the turntable, which if removed, considerably reduces the antiskate force. On the turntable reviewed, the antiskate force was slightly excessive, producing a difference of approximately 1.8dB between the left and right channels when checked with a 1kHz tone.

The measured performance of the turntable was quite good with the linear unweighted signal to noise ratio of the complete system being 43dB. This level was predominantly hum pick-up from the four-pole synchronous motor. The A scale weighted signal to noise ratio of the complete system was 57dB. The wow and flutter was higher than Sonab's specification, being 0.4% RMS. This appeared to be due to an irregularity in the belt and possibly a high spot on the drive rim. For interest we produced a spectrogram of the output

SONAB MODEL 85S TURNTABLE



frequency from the turntable (using a 1kHz test tone) to see how speed varied during each revolution. The spectrogram clearly shows the flexing of the belt during each revolution. The results are typical for any belt drive turntable and highlight why a belt drive turntable generally has higher wow and flutter than a rim drive type turntable.

INSTALLATION AND OPERATING KIT

The Sonab 85S is the only record player we have reviewed to date which is supplied with a comprehensive installation and operating kit. This kit includes

(i) a record cleaner with cleaning brush
(ii) a plastic container of oil for the motor bearings
(iii) an additional counterweight if a heavy cartridge is to be used
(iv a 45 R.P.M. record centre
(v) a styling brush
(vi) a small screwdriver
(vii) a plastic bag containing an untreated blue cloth and a small squeeze tube of some perfumed liquid, presumably for cleaning extremely dirty records, (if we could read Japanese we would know!)

Apart from all this, there is also a pair of tweezers for removing and fitting the leads to the cartridge pins – a very useful and worthwhile inclusion.

The instruction manual, as with all Sonab manuals, is written in four languages and is arranged in a logical sequence, starting with unpackaging instructions and followed by installation and operating instructions. Under the heading of "The Records" is some very noteworthy advice:-

"this has been said many times before, but is nevertheless worth repeating:
Take good care of your records.
Never touch the playing surface with your fingers.
Grip the record at the edge only.
Do not allow dirt to accumulate in the grooves. The stylus is made to reproduce music, not plough through dust and dirt."

There are a couple of minor errors in the manual. In the illustration showing how to align a cartridge correctly Sonab incorrectly show the stylus in front of the white mark, and not directly below it as detailed in the written instructions. The other error in the instructions is in the "technical specification" and shows the output signal as "16.8mV RMS." instead of 6.8mV.

The Sonab 85S record player adequately combines automatic control with a belt drive turntable and is complemented by a very good quality Shure cartridge. A few minor changes to the cueing control and the antiskate adjustment would make it a very good unit. At a recommended selling price of $218 the Sonab 85S record player compares favourably, particularly in appearance, with many other automatic record players. ●

MEASURED PERFORMANCE OF SONAB MODEL 85S

TURNTABLE SERIAL No. 04023

Frequency Response 20 to 20kHz	$^{+3}_{-0.5}$ dB
Channel Separation At 1kHz	28dB
Channel Difference	1.8dB
Sensitivity at 1kHz (re 5 cm/sec)	6.3mV
Signal to Noise Ratio (complete system re 1kHz at 5cm/sec)	43dB
Wow and Flutter	0.4% RMS refer spectrogram
Hum And Rumble Equalized But Unweighted (re 1kHz at 5cm/sec)	43dB
Cartridge Weight	6.04 grams
Turntable Weight	3lbs.
Dimensions Width 17-3/8" x Depth 14-1/2" x Height 6-3/8"	
Recommended Selling Price	$218

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DB111

The magic round about

The Sonab omnidirectional stereo system is unique.

It's protected, in depth, by watertight world patents.

The speakers fill the whole room with stereo sound. Instead of that one short static line you get with conventional forward facing systems.

Most companies would be content with that sort of breakthrough.

At Sonab it's not good enough.

Because there's not much point in producing a unique speaker system, if the hardware that feeds the sound in isn't up to much.

So to complement their speakers, Sonab produce some very remarkable audio equipment.

Sonab turntables.

They're not unique.

Just incredibly well designed and engineered. As you would expect. Right down to the perspex cover which stays up when you lift it, and stays on while the record's playing.

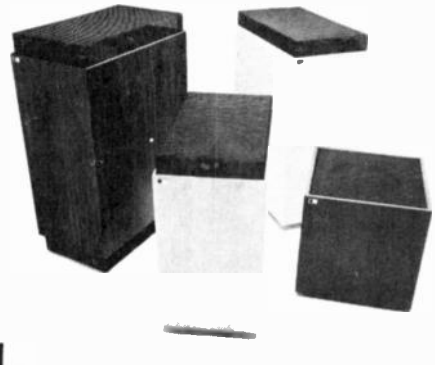
The decks are incredibly simple to operate.

And are incredibly sophisticated in operation.

Aesthetically they're beautiful to live with. And the performance, of course, is unbeatable.

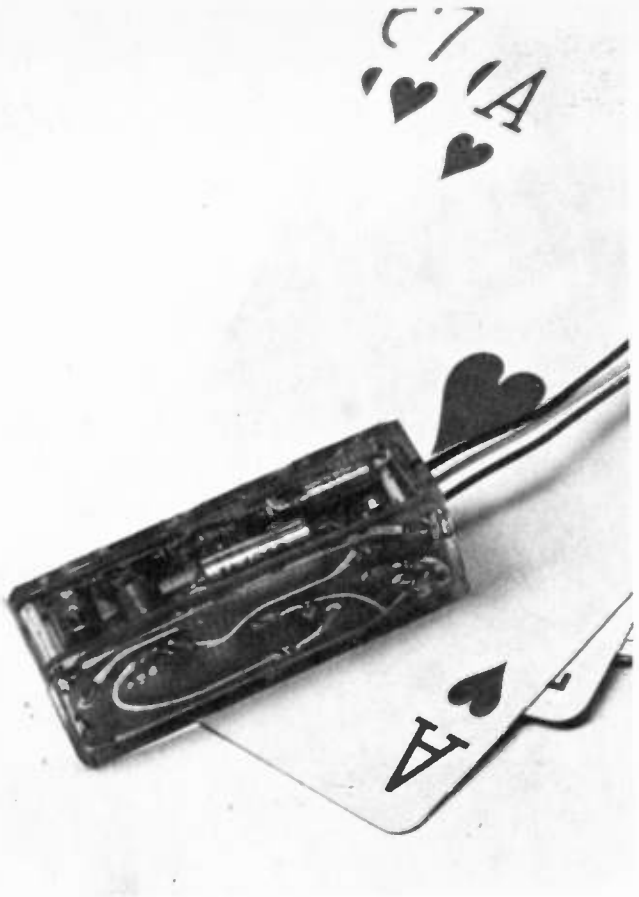
The prices, not surprisingly, are far from cheap.

For literature on Sonab turntables and the rest of the Sonab range — and the name of your nearest dealer, phone or write to us.



Sonab

Sonab of Sweden Pty. Ltd., 114 Walker Street, North Sydney, N.S.W. 2060. Telephone: 929 4288/4554.



NUCLEAR HEART PACEMAKER

Latest heart pacemaker may have a life span exceeding ten years.

A NEW type of heart pacemaker is currently under development in USA. Employing electronic modules built to aerospace reliability standards, the devices will be powered by nuclear energy to give them a life of 10 years instead of two, as presently experienced with mercury batteries.

Raytheon is building the units for ARCO Nuclear of Apollo, Pennsylvania, a wholly-owned subsidiary of Atlantic Richfield. The experimental programme is being conducted by the Atomic Energy Commission to study the reliability of the new devices and determine whether or not they can be produced as reliably as, and at an expense comparable to, contemporary pacemakers.

The programme was instituted by the AEC after studies indicated that as many as half of all contemporary pacemakers fail in less than two years and none has ever completed four years of operation. In addition to promoting peace of mind for the patient whose well being depends upon an artificial heart timer, the extended-life devices now in pilot production could dramatically reduce expense and inconvenience to the patient who must now submit to chest surgery at frequent intervals within the reliability life span of present pacemakers.

The new devices weigh about half as much as present models. They have been extensively tested in laboratories with animals. Clinical testing in humans will begin once the AEC is thoroughly convinced that the unit is 100 per cent safe and reliable for human beings.

About 50,000 persons now depend upon pacemakers. It is estimated that an additional 5,000 to 10,000 will join their ranks annually as the reliability and longevity of the devices is increased.

Electronic circuitry of contemporary pacemakers outlasts the present mercury power sources but with the shift to nuclear energy and its 10-year life, the circuitry had to be upgraded ●

PRACTICAL GUIDE TO TEMPERATURE CONTROL

PART III

In this article Collyn Rivers explains how to obtain really precise temperature control.

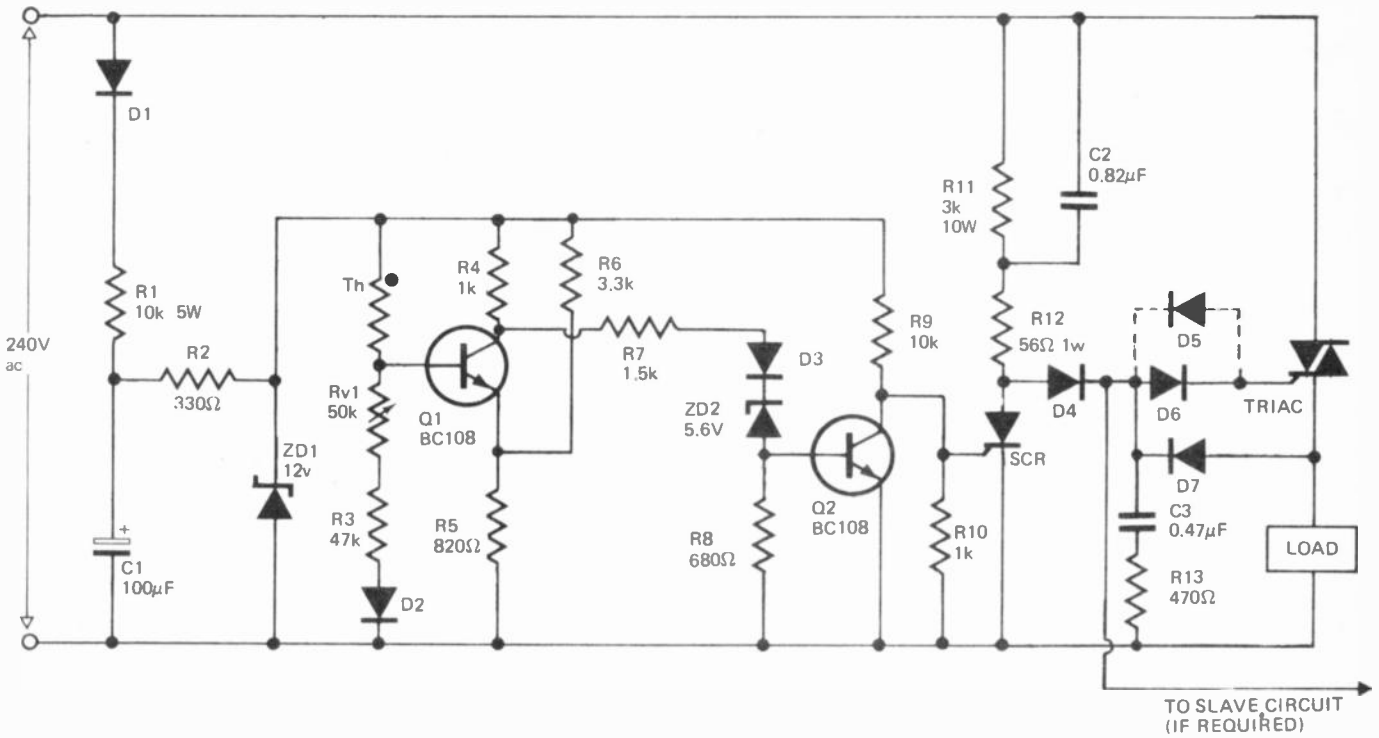


Fig. 1. Triac should be selected to suit the load, thermistor resistance should be approximately 100k at sensing temperature.

THE temperature control circuits described in parts one and two of this series are capable of maintaining temperatures to within ½% to 1% of the 'set' temperature.

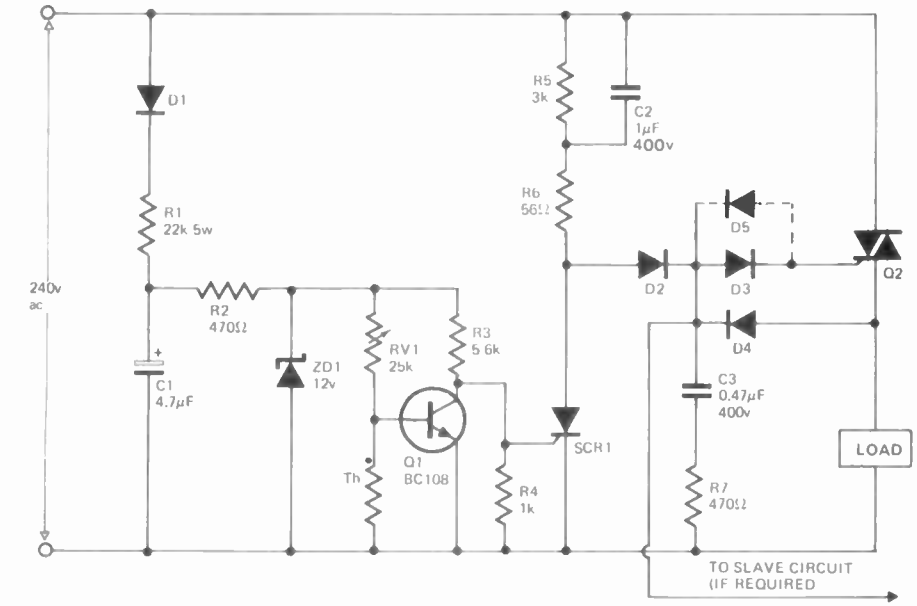
A temperature differential of this magnitude is adequate for the vast majority of engineering and laboratory applications. Nevertheless there are some applications where a temperature differential of 0.1% or better is required. Here then are two circuits capable of maintaining temperatures within this level of accuracy – we have also included a simplified version of one of these circuits which can maintain temperatures within 0.15%.

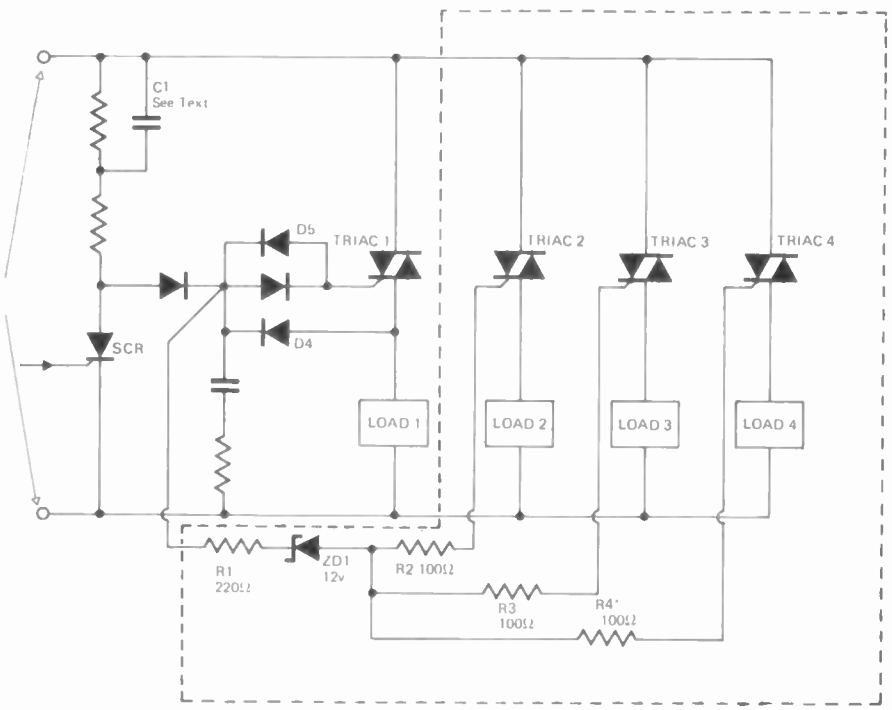
All three circuits utilize the 'zero-voltage switching' technique in which the output Triac is switched on for entire cycles and off for entire cycles, control being achieved by varying the ratio of 'on' cycles to 'off' cycles.

The circuits shown in this article are all capable of 'slave-driving' a number of additional Triacs each supplying a separate heating element. Thus heating loads varying from a few watts to many thousands of watts may be controlled by selecting Triacs of the required ratings in suitable combinations. It must however be borne in mind that massive heating control systems are generally more economic to build using inverse-parallel SCR's.

Figure 1 shows a control circuit capable of maintaining a differential better than 0.1°C at temperatures between 10°C and 150°C.

In this circuit D1,R1,R2, and Zener





diode ZD1 provide a regulated dc power supply for the sensing circuit consisting of the thermistor (Th), R3, D2 and 'temperature set' potentiometer RV1. Power is also supplied by this circuit to transistor Q1 and Q2.

A change in the resistance of the thermistor causes a change in the base current of Q1. This change is dc amplified and is then used to turn the SCR on or off. The SCR, in turn, synchronously clamps and unclamps the mains-derived trigger voltage to the Triac.

The triggering action is slightly more complex than at first it may appear. Assuming that the SCR is in the 'off' state, the Triac is triggered via R11, C2, R12, D4 and D6 during the initial period of the positive going sine-wave of the 240 volt line. As soon as line voltage appears across the load, capacitor C3 charges positively (relative to the low side). At the start of the negative-going part of the mains waveform, C3 (which still carries a positive charge), discharges via D6 thus triggering the Triac for the negative going half-cycle.

Diode D5 – shown dotted in Fig.1 – is used only when the circuit is used to slave-drive other Triacs. If only one Triac is used then D5 may be omitted.

Again, when only one Triac is used in this circuit, it may be necessary to increase the value of capacitor C2 in order to reduce the conductive RFI caused by a small notch formed at the beginning of the positive going waveform.

Figure 2 shows a simplified version of the above circuit. In this version, temperature may be controlled within 0.2°C between 10°C and 150°C.

Circuit operation is very similar to that of Fig.1, with the exception that only one transistor is used. The differential of this circuit is largely a function of the gain of the transistor (Q1). the higher the gain, the smaller

Fig. 2. (top) This circuit is a simplified version of that shown in Fig. 1. Thermistor resistance should be approximately 2k at sensing temperature.

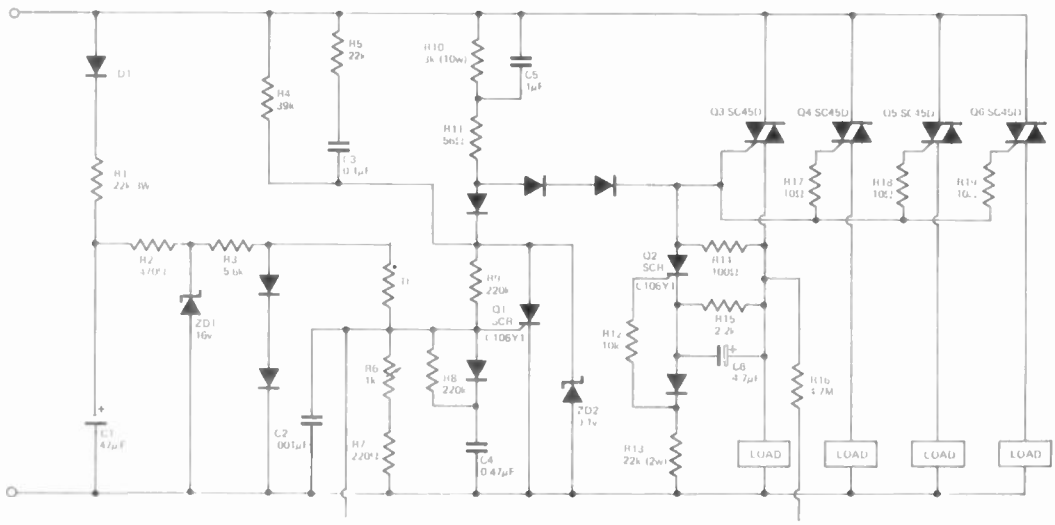


Fig. 3. (centre) Slave circuit may be driven from either of the circuits shown as Fig. 1. and Fig. 2. Note – additional components are shown inside dotted lines.

Fig. 4. (right) This circuit may be used for either on/off or proportional operation.

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PRACTICAL GUIDE TO TEMPERATURE CONTROL

the temperature differential If the smallest possible differential is required, than a BC108B or BC108C should be used for Q1. (It is not always realized that the BC108 transistor is manufactured in three different types – labelled BC108A, BC108B and BC108C in order of ascending gain).

SLAVE-DRIVE CIRCUITRY

Figure 3 shows the slave-drive circuit that may be used with Figs. 1 and 2. For clarity, the output stage of Figs. 1 and 2 has been shown – and the additional circuitry required for slave driving is that shown within the dotted lines.

In operation, as soon as Triac 1 conducts on the positive half-cycle of line voltage, gate currents are provided for the additional Triacs via parallel diodes D4 and D5, resistor R4 and Zener diode ZD1. The purpose of ZD1 is to act as a buffer between the master Triac (1) and the slaved Triacs.

Resistor R4 must be selected to suit the individual application. Its value depends on the size and number of the extra heating loads and the operating temperatures of the Triac junctions. For three slaved Triacs the value shown (220 ohms) will be about right, however this may need to be increased to 470 or 560 ohms if the loads or number of Triacs are increased. If this resistor is increased in value beyond 600 ohms or so, RFI may be become a problem. Capacitor C1 (shown as C2 in Figs 1 and 2) should be selected to provide optimum temperature differential combined with low RFI.

ON-OFF OR PROPORTIONAL OPERATION

The circuit shown in Fig. 4 is unusual in that it may readily be changed from 'on-off' to proportional operation – both modes nevertheless utilizing zero-voltage switching.

It is slightly less accurate than the circuits shown in Figs. 1 and 2 but nevertheless can maintain temperatures to within better than 0.4%.

As shown, the circuit operates in the proportional mode, 'on-off' operation is effected by deleting components R8, R9, C4 and D4.

The total heating load controllable by this circuit – using the components specified – is 9.6 kW. Naturally if smaller loads are used, then any or all of the slaved Triac stages (Q4, Q5 and Q6) may be omitted.

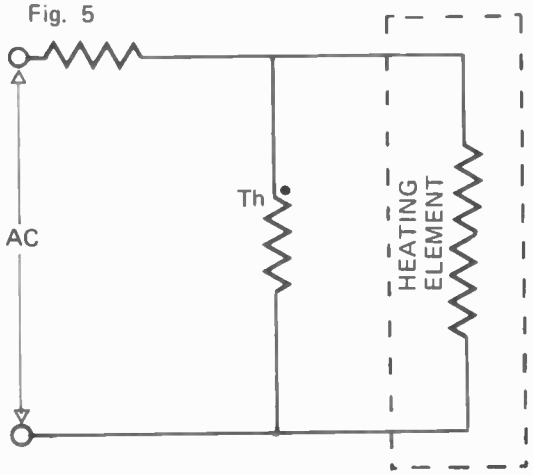
INTEGRATED CIRCUITS

The circuits described in this month's article have slightly complex control circuitry. They are capable of excellent performance and use components that are readily available.

Recently however, zero voltage switching integrated circuits have become commercially available and these in effect may be used to replace practically the entire control circuitry of the circuits shown in Figs 1 and 2. Circuits using this type of IC will be described in the next part of this continuing series – it is suggested that readers who are considering building high precision zero voltage switched controllers should wait until they have read this next article before commencing construction. ●

Fig. 5. Constant temperature control of small enclosure is achieved using this circuit.

Fig. 5



Several readers have asked us for a really simple circuit for maintaining a constant temperature inside a small enclosure.

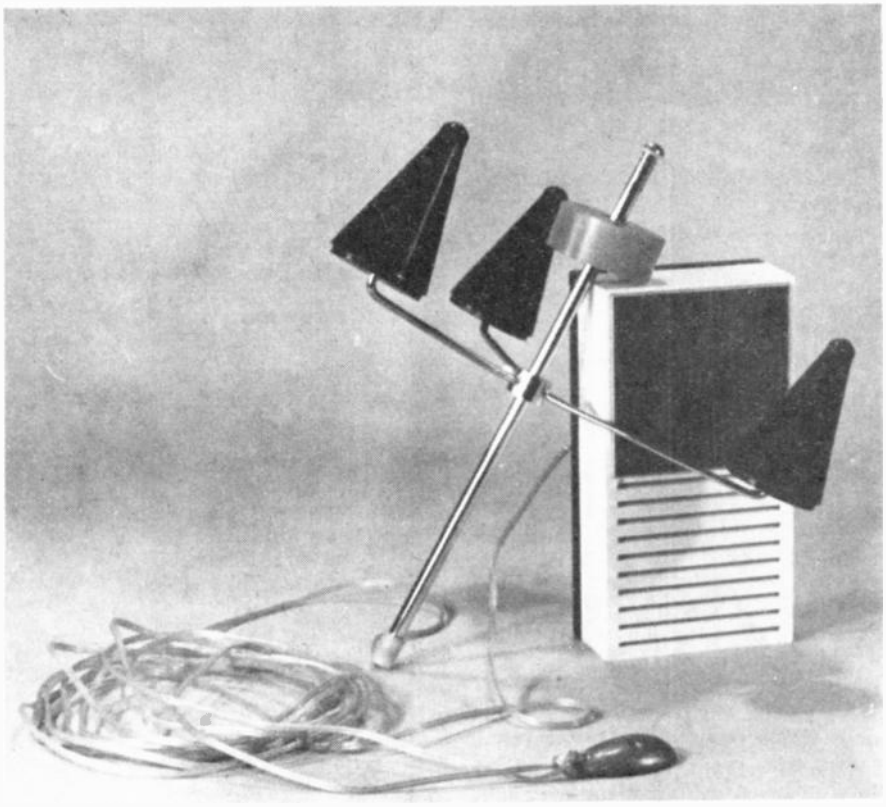
The very simple circuit shown in Fig.5 is often used. Temperature differential is about 3°C.

In this circuit the thermistor is mounted outside the container but is connected in parallel with the heater. As ambient temperature rises, current through the thermistor will increase, hence decreasing current flow through the heating element.

The thermistor chosen must of course be large enough to dissipate the external current without excess heating.

SWIMMING POOL

Readers were invited to submit designs for equipment capable of detecting a small child falling into, or about to fall into a domestic swimming pool.



Entry from Mr. G. Goodwin used a double float technique. The sensing float, which is free to move vertically, contains a bar magnet.

Outright winner of our swimming pool alarm design competition is Mr. John C. Scott of Kenmore, Queensland.

Congratulations John! You will shortly be the recipient of $1000 worth of Sansui Hi-Fi equipment.

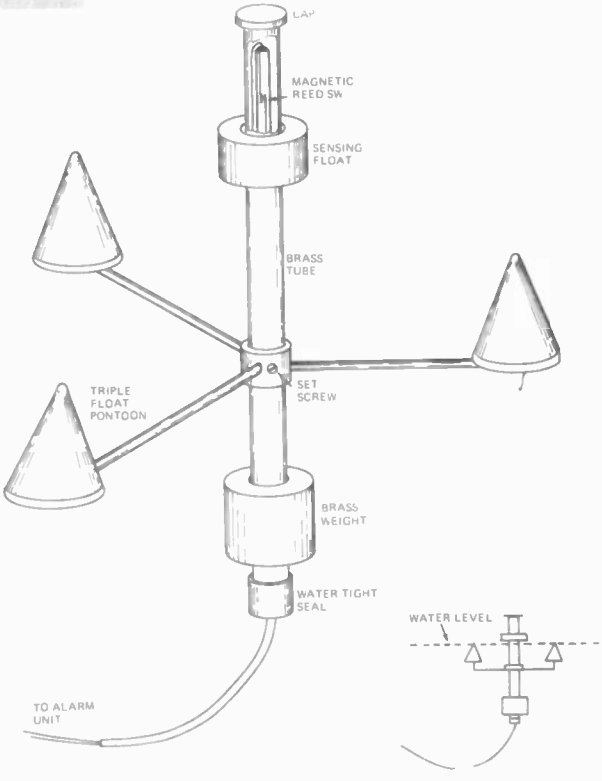
The final judging was an extraordinarily difficult and protracted affair. We received far more entries than we originally expected and the standard of design and engineering of most of the entries was very high indeed.

Our ten finalists' entries were judged in terms of practical design, sensitivity and noise rejection in a typical suburban swimming pool. From this, three final contenders emerged. These were:—

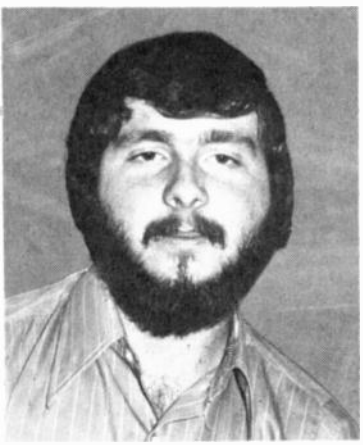
Mr. John C. Scott
Fairey Australia Pty. Ltd.
Mr. G. Goodwin

The above listing is in order of our final assesment.

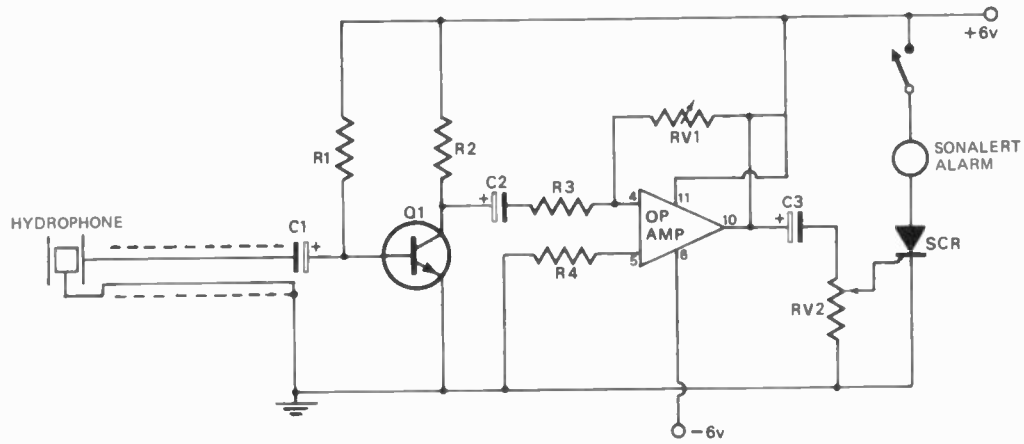
Following is a brief technical description and our evaluation of each of these three designs.



SAFETY CONTEST
FINAL RESULTS



Mr. John C. Scott.



Simplified circuit of the winning entry. Hydrophone is a commercially available unit.

Mr. J.C. Scott,
Kenmore, Queensland.
(Hydrophone).

Operating Principle.

A hydrophone (underwater microphone) is suspended below the surface of the water, or placed on the bottom of the pool in order to sense the sound of the splash. Ideally this type of alarm should be triggered by components of the splash but be insensitive to other background noise – such as rain or thunder.

In John Scott's alarm the output of the hydrophone is fed to a simple transistor pre-amplifier having a gain of 50, and this is followed by an operational amplifier having a gain of 900.

The amplified signal, when above a preset threshhold, triggers an SCR into conduction thus applying power to a "Sonalert" type alarm. A remote alarm may be used if desired and test and alarm-reset facilities are provided.

Evaluation:

Although only in rough prototype form, the unit worked very effectively and was extremely sensitive. Merely swishing a hand in the water 15 feet from the sensor was sufficient to trigger the alarm instantly. At maximum sensitivity the alarm was found to be unaffected by wind ripples or by external background noise, but was occassionally triggered by falling rain. With the sensitivity reduced slightly – there is a pre-set adjustment – detection was still more than adequate.

A special mention must be given to Mr. Stanbridge of Western Australia. Mr. Stanbridge's design – which was very similar to that of our winning entrant – was very thoroughly engineered. However in the final selection Mr. Stanbridge's entry exhibited some instability at settings adequate to detect the splash caused by a falling child.

Fairey Australia Pty. Ltd.
Hydrospace "Poolguard"
Operating Principle

This was by far the best of the commercial units presented.

The Hydrospace alarm is a polythene-foam float which carries a pair of metallic sensor probes. The float is weighted down into the water by one lead weight and anchored in a position by another weight on the bottom of the pool via a length of cord. Thus the sensor automatically adjusts to overall changes of pool water level. The prongs are adjusted to about 5/8 inch above the surface of the pool and in this position the unit is claimed to have maximum sensitivity without being triggered by wind ripples.

When a wave occurs, the two probes are immersed and the effective resistance across them is lowered. This triggers an SCR into conduction energizing a "Sonalert" alarm. Test and alarm reset facilities are provided.

Evaluation:

Sensitivity is adjusted by bending the prongs towards, or away from, the water. Although this adjustment appears simple, in practice it was found a little difficult to get the exact setting required. In operation the unit was definitely superior to all other float type units. It was less prone to be triggered by wind ripples than the Goodwin unit as a wave had to be fairly broad (unlike wind generated ripples) in order to touch both sensors. Short, sharp wavelets had no effect. The unit was nowhere near as sensitive as the hydrophone units and was not instantaneous, i.e. in large pools ripple propagation between a child falling in and the alarm triggering could be several valuable seconds.

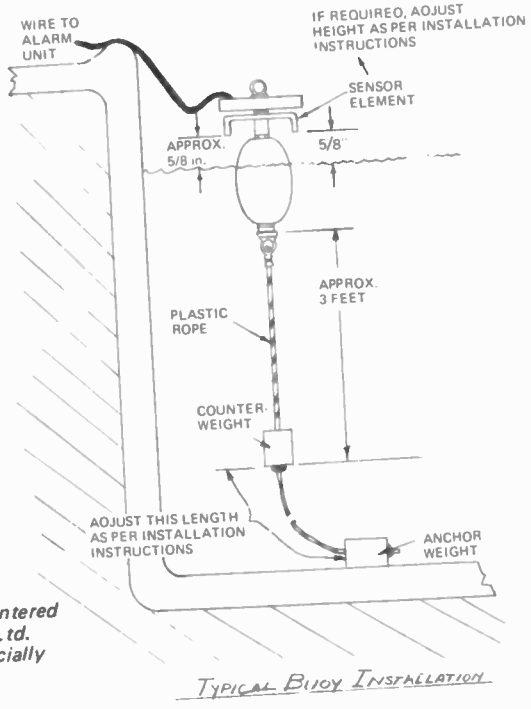
In our opinion this was the second best unit to be submitted and has the advantage of being rugged and relatively cheap.

Mr. G. Goodwin – Sydney
(Float System)
Operating Principle

The system used a float within a float principle.

The sensor assembly is supported on the surface of the water by three small

CONTEST



Hydrospace 'Poolguard' entered by Fairey Australia Pty. Ltd. (this unit is now commercially available).

floats. A control pillar carries a further small round float which has a hole in the centre and is able to slide up and down the pillar. A reed switch is mounted in the pillar and a magnet is located within the float.

By means of the double float principle, the sensor is rendered insensitive to overall changes in water level, and only those waves which are as short, or shorter, than the diameter of the pontoon float assembly will trigger the alarm. Thus on short waves the inner float will rise up the centre pillar and the magnet in the float will cause the reed switch to close. The alarm, once triggered, locks in and switches on a "Sonalert" type alarm. This unit also provides test and alarm-reset facilities.

Evaluation:

The prototype was well made and offers improved performance over many commercial types currently on the market. When adjusted to a sensitivity such that it would reliably detect the test object (1 gallon container filled with water) thrown into the pool 15 feet from the sensor, it was prone to false alarms due to wind ripples and in this respect was inferior to the Hydrophone model.

A design by Mr. J. Olson of Epping, N.S.W. showed great potential and it was a pity that he was unable to submit a prototype.

In this design a vertical array of three horizontal light beams surround the perimeter of the pool. A logic system then actuates the alarm when the bottom two beams are broken. Small animals, birds, or flying leaves would interrupt only one beam – adults would interrupt all three and in both cases the logic circuit would negate the alarm.

FINALISTS

G. Collins, N.Z.
G. Goodwin, NSW
J. Olsonn, NSW
S. Tusak, Vic
J.F. Brandwyk, SA
J. Scott, Qld
D. Knox, Vic
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Space limitations preclude us from publishing details of all the finalists' designs but we will shortly publish one or more projects for home construction based on the winning entries.

So once again, congratulations to Mr. Scott – shortly to be the possessor of some very fine Sansui Hi-fi equipment – our thanks to the Bleakley Gray organisation for their support, and not only our thanks but also our genuine admiration to all those who participated in this competition for the excellence and abundance of entries. ●

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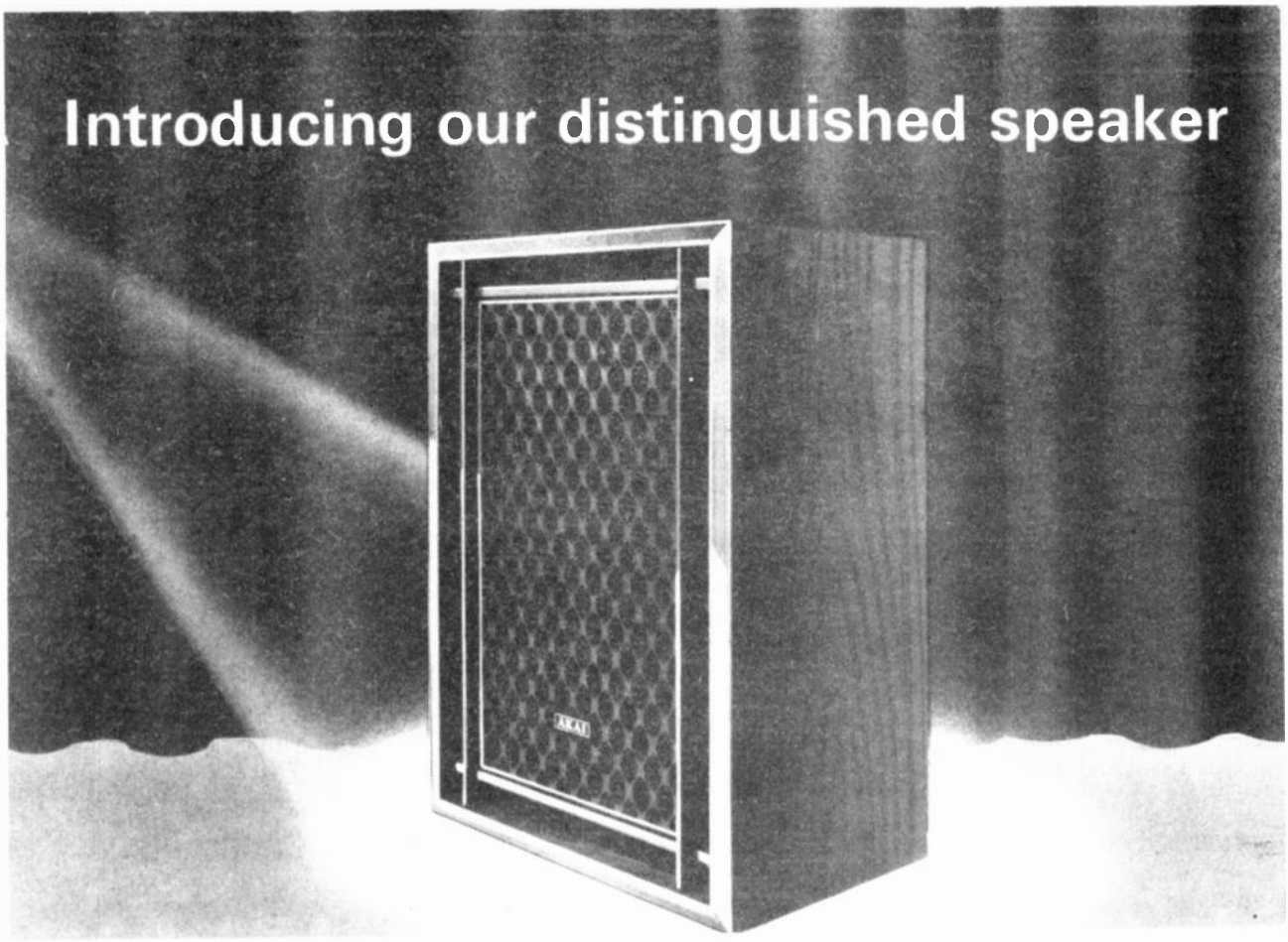

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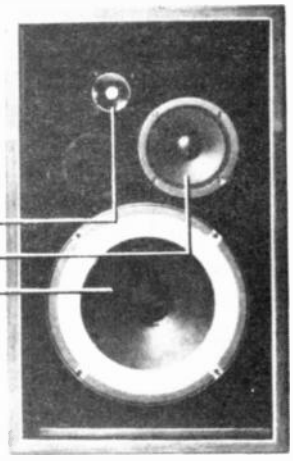

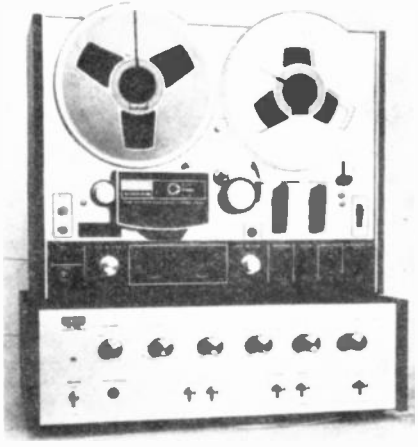

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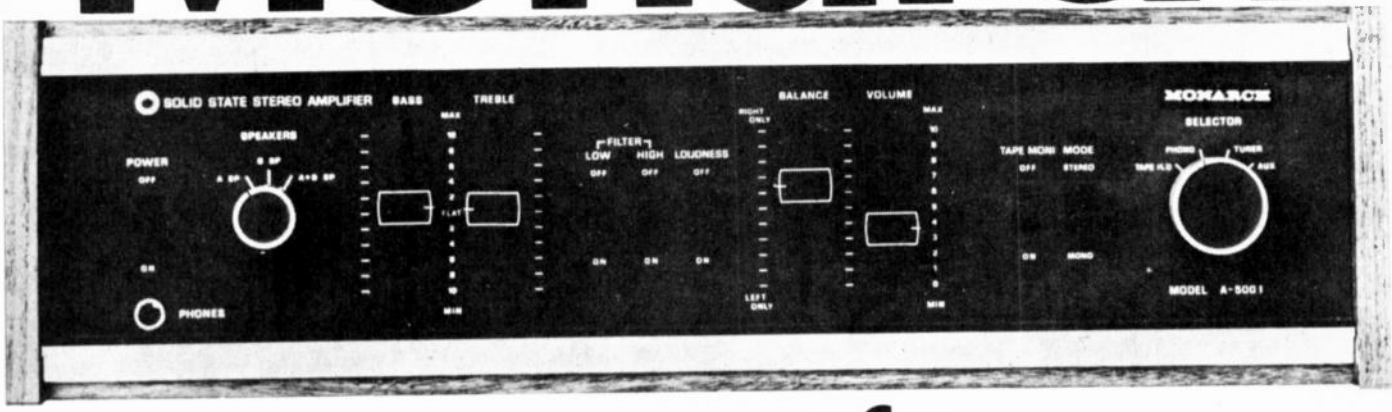

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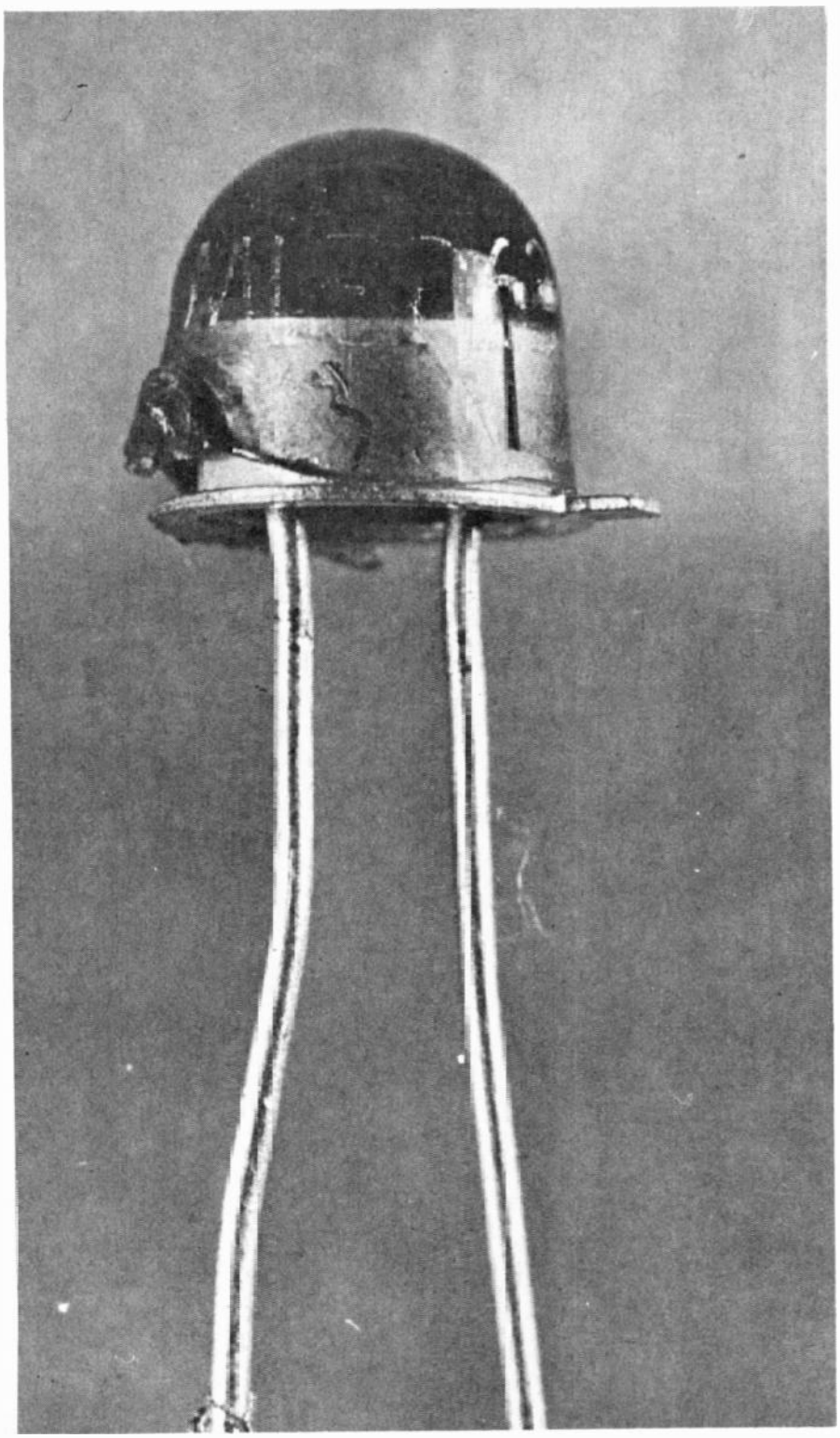

Typical LED from Motorola is shown over ten times full size.

The light emitting diode is a fully solid-state light-source which is having a far reaching effect on equipment technology.

LIGHT emitting diodes (LED) are semiconductor diodes which have the property of converting electric power into electro-magnetic radiation at specific narrow wavelengths within the infrared or visual regions. These devices are having a considerable impact on modern technology and equipment techniques due to several factors:—

1. Their speed of response is many times greater than that of incandescent lamps, they work very well at frequencies from dc to well into the megahertz region. Some diodes have been produced which operate at speeds up to 100 megahertz.
2. They are rugged devices much less prone to mechanical damage than their glass bulb counterparts. They are not subject to microphony nor affected by vibration in any respect.
3. LED's have no warm up time and the light output is monochromatic (narrow bandwidth). Although LED'S do not normally produce coherent light, diode lasers are available.
4. The LED is a low voltage, low current device and can readily be interfaced with transistor or IC circuitry. Some equipment manufacturers are now using LED's as monitors to provide a visible indication of circuit malfunction. This application will become more widespread as LED prices fall, and will vastly reduce equipment servicing time.
5. The life of an LED is of the order of 20 to 30 years in contrast to 5-10,000 hours for incandescent or neon lamps.

Up until fairly recently the price of these devices has prevented their widespread use — $18 each in 1969. Nowadays, in quantity, they can be obtained for around 70c each and will no doubt be priced even lower in the near future. Apart from discrete device applications LED's are also being

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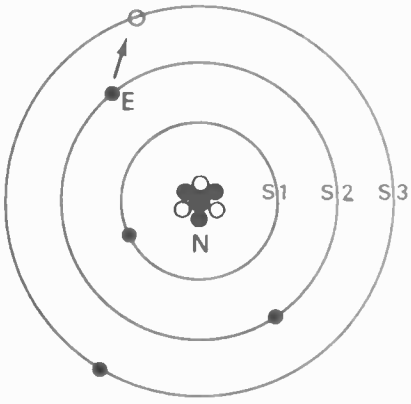


Fig. 2. The structure of a typical atom showing the energy level transition of an electron.

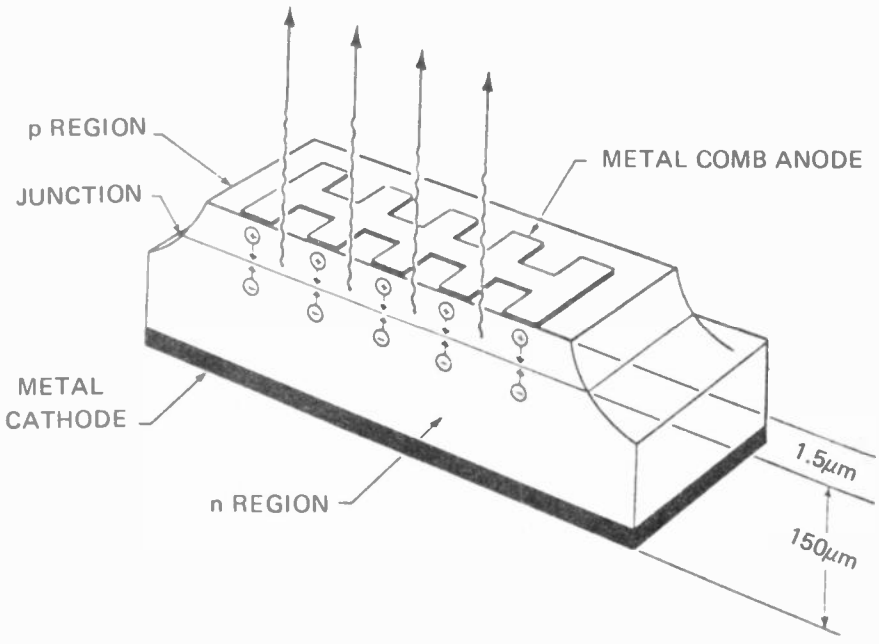


Fig. 1. Each light emitting diode chip is a simple mesa-structure

integrated into alpha-numeric displays which in some cases include the count/store/decode electronics in the same package.

The devices are manufactured from three basic materials. These are – gallium arsenide, which produces infrared radiation (wavelength 900nm approximately) when the device is forward biased, or – gallium arsenide phosphide, which produces visible red light of about 660nm, and lastly, gallium phosphide which produces green light of about 560nm or, red light of 700nm depending on the dopant used. Gallium phosphide devices are not generally available as yet but this material will probably be that most favoured in the future for visible emitters.

Some earlier experimental devices were manufactured from silicon or germanium, but although they did produce infrared, they were very inefficient, and only reached the commercial market in limited quantities.

STRUCTURE OF GASP LED'S

Each light emitting diode chip is a simple mesa structure as shown in Fig. 1. An epitaxial layer of n-type gallium arsenide phosphide is grown on a gallium arsenide substrate. Impurities are then diffused into the epitaxial layer to form a very shallow p-region. The cathode contact is plated onto the n-region, and the anode contact is evaporated into the p-region.

THEORY OF OPERATION

The physics of semiconductor light emission is entirely different to that for incandescent lamps. The light emission of an incandescent lamp is due to the heating effect of the current, in contrast to this, the energy emitted by an LED is produced by a phenomenum known as electro-luminescence. This phenomenon is not necessarily associated with heating and hence is quite commonly known as cold light. There are many examples of cold light production in nature – for example fireflies, some deep sea fish, marsh gas etc. to mention just a few.

Luminescence is produced by electron energy level transitions. Reference should now be made to Fig. 2. which shows the familiar structure of an atom with nucleus N and electrons E rotating in orbital shells S around the nucleus. If the atom receives energy in form of radiation heat or collision etc. an electron in the outer shell may be stripped off altogether, or alternatively, it may be raised to a higher energy level, that is, for example, from shell 2 to shell 3. When the source of energy is removed, the electron will fall back to its original orbit and in doing so, will release the acquired energy in the form of a photon of radiation. The wavelength of the emission is directly proportional to the difference between the two energy levels in electron-volts and depends on the material.

In the case of a photo diode in the forward biased condition, the current flow causes electrons to be raised to a higher energy level in the N material, and in this state it crosses the PN junction. It then falls from this energy level and recombines with one of the

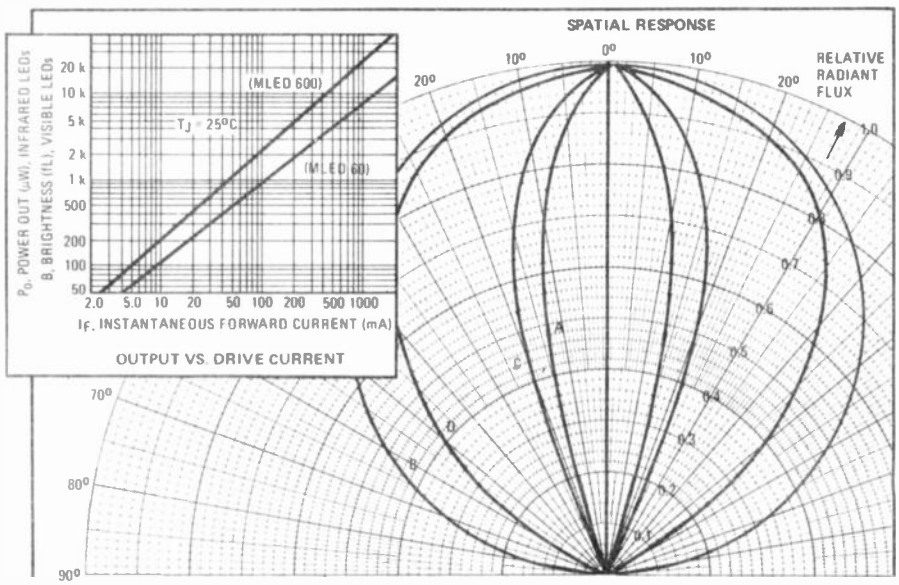
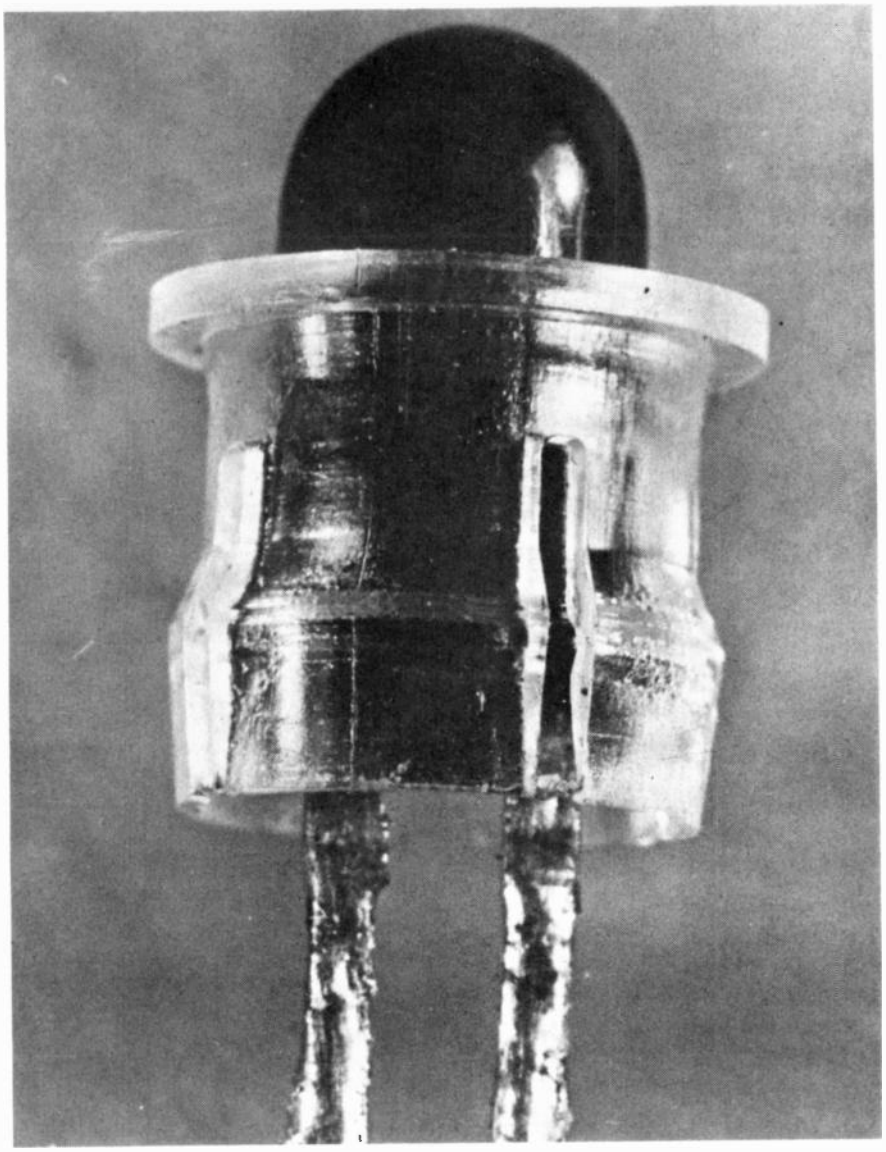


Fig. 4. Typical characteristics of commonly available LED's. Graph, upper left, shows typical light output as a function of drive current. Spatial response curves are functions of package and lens designs.



holes in the P material with a consequent emission of a photon of light.

Factors effecting the overall efficiency of a light emitting diode chip are:

1. Quantum efficiency, or percentage of recombinations which produce photons. This is the ratio of the number of photons produced to the number of electrons passing through the diode. Quantum efficiency can be as high as 50% in LED's
2. Absorption of photons within the p-region.
3. Internal surface reflection due to the difference between the refractive indices of the LED material and air. For example for GAsP, n = 3.5 (in air n=1.0) All photons making an angle of greater than about 17° with the normal to the surface of the chip are internally reflected and absorbed.
4. Contact resistance and bulk resistance.
5. Optical losses due to the package and lens.

Factors contributing to loss of efficiency are illustrated diagrammatically in Fig. 3. .

The overall efficiency of a diode producing visible light is called luminous efficacy. It is the ratio of the optical energy out to the electrical power in, and is expressed in footlamberts per unit current density. The term efficacy is used rather than efficiency because the light output is measured in terms of the response of the eye to the emitted radiation. (see Fig. 4.) A typical value for luminous efficacy is 50 fL/A.cm^2 in presently available materials. This corresponds to an overall power to light conversion efficiency of about 3% with efficiencies as high as 7% being reported from laboratories. In the microamp current range, electroluminous efficacy is very low, but increases with increasing current and hence diode luminance increases at a greater rate than diode current. Luminous efficacy increases nearly linearly with increasing current.

In GAsP devices, the relative amounts of arsenide and phosphide may be varied. This permits manufacturing control over the recombination energy (bandgap) and thus the wave-length of emitted light. The alloy composition also effects the electro-luminous efficacy as shown in Figs 5a/5b.

Peak eye sensitivity occurs at 555nm, and as Figure 5a shows, it is the product of eye sensitivity and diode radiant efficiency which determines optimum wavelength for maximum luminous efficacy.

Potential light emitting materials are classified as having either direct or indirect bandgaps.

In direct materials, the electron jumps directly from one energy level to another lower one, releasing a certain amount of energy. To be a candidate for electroluminescence this energy jump must produce radiation with a wavelength falling in the visible spectrum.

In indirect materials, electrons may take one of many different paths in seeking the lowest energy state. Some paths will be of the correct energy to produce light; others will produce infrared (heat). In addition to natural intermediate energy levels, other levels may occur due to lattice imperfections

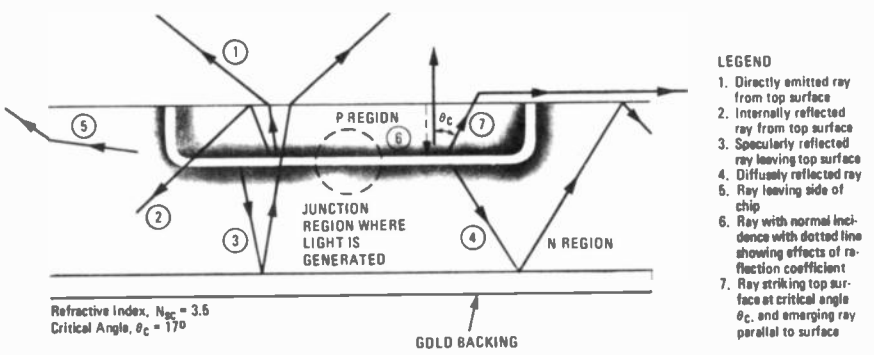


Fig. 3. This illustration depicts factors contributing to internal losses in LED diodes.

Table I
Common Electroluminescent Materials

Material	Energy Gap, eV	Band Structure	State of Development
GaN	3.5	direct	A
SiC	2.8–3.2	indirect	B
$Al_xGa_{1-x}P$	2.26–2.45	indirect	A
GaP	2.26	indirect	C
AlAs	2.16	indirect	A
$In_{1-x}Ga_xP$	1.34–2.26	direct-indirect	B
$In_{1-x}Al_xP$	1.34–2.45	direct-indirect	A
$GaAs_{1-x}P_x$	1.44–2.26	direct-indirect	C
$Al_xGa_{1-x}As$	1.44–2.16	direct-indirect	C

*A still in experimental stage; B some commercial production; C wide commercial usage.

Low current LED digital readout has been chosen by Hewlett Packard engineers for this model 5303B 525 MHz frequency counter.

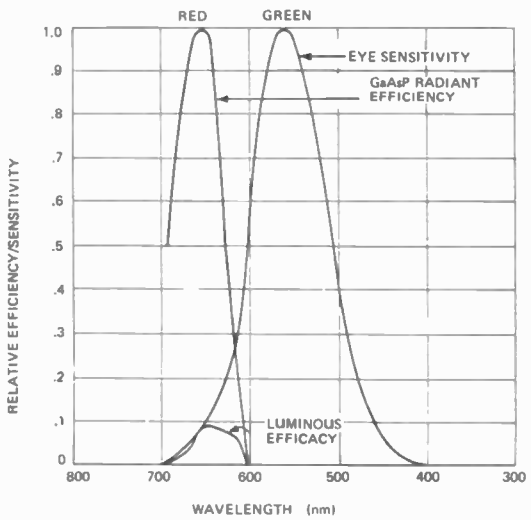


Fig. 5a. Relative Efficiency/Response versus wavelength for GaAsP LED's.

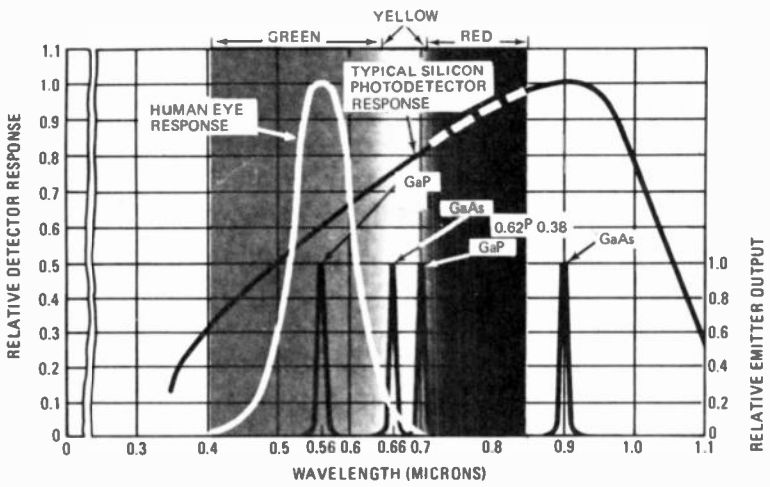


Fig. 5b. Spectral output of various LED materials compared with the response of the human eye and a typical silicon photodetector.

or impurities. That radiation produced by direct transitions is called resonance radiation.

GaAs is a direct material, whereas GaP is indirect. Thus, at some points the composition GaAsP is a direct material and at others it is indirect. In the alloy formula GaAs (1-s) Px, the crossover occurs at about x = .45.

Other electroluminescent materials include gallium phosphide (indirect), gallium arsenide (direct) coated with lanthanum fluoride, silicon carbide (direct) and gallium indium phosphide (direct or indirect, depending on composition). A comparison of various LED materials is shown in Table 1. Table 2 provides details of current LED characteristics.

Table II
Characteristics of current LEDs

Material	Color	Peak Wavelength, A	Lum. Eff., Lumens/watt	Conv. Eff., percent	fL/A-cm^{-2}
GaP:Zn,O	red	6900	20	3–7	350
$Al_{.3}Ga_{.7}As$	red	6750	16	1.3	140
$GaAs_{.6}P_{.4}$	red	6600	42	0.5	145
$In_{.42}Ga_{.58}P$	amber	6170	284	0.1	310
$GaAs_{.5}P_{.5}$	amber	6100	342	0.013	35
$GaAs_{.25}P_{.75}$:N	amber	6100	342	0.04	40–100
SiC	yellow	5900	515	0.003	10
$In_{.4}Ga_{.6}P$	yellow-green	5700	648	0.02	115
GaP:N	green	5500	677	0.05–0.6	470

(Continued on page 47)

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Model A-210

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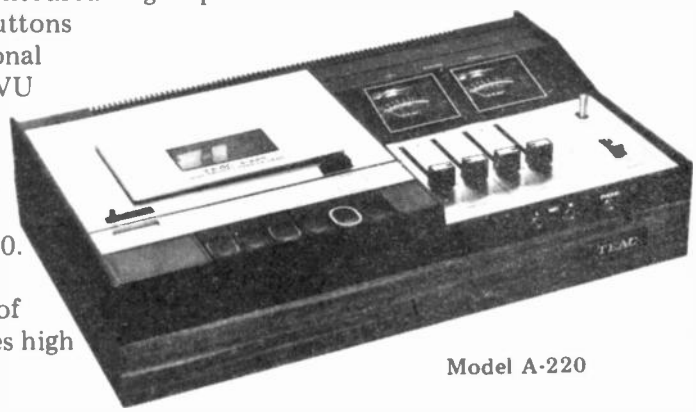

Model A-220

If you're looking for a deck that can handle the new chromium dioxide tapes, you should look into the TEAC A-220. It has the add-on feature of a tape selector switch in the CrO2 position, provides recording and playback frequency response of 30-16,000Hz. As an added convenience, the A-220 incorporates high density ferrite heads and separate record and output level controls.

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OPTO-ELECTRONICS

APPLICATION OF OISCRETE LEO'S

Light emitting diodes which generate visible light are finding their main applications as panel lights, circuit-condition indicators, light modulators, displays and the like. Infrared emitters on the other hand are used in card readers, shaft encoders and other applications where visibility is not only not required, but may be an embarrassment (e.g. burglar alarms). At infrared wavelengths maximum transfer efficiency is achieved when LED's are used with silicon photo detectors.

OPTICAL COUPLERS

An excellent example of the use of LED's in systems application is the optical coupler. The optical coupler consists of an LED and a phototransister in a single package. This device is an almost ideal replacement for such components as interstage transformers and relays as well as coupling and feedback networks.

Important characteristics of these devices are:—

1. Signal transfer is in one direction only. Radiation from the LED is detected by the phototransister, but the reverse cannot happen. Thus an amplifier fed from an oscillator by means of such a coupler, cannot possibly have any detuning or pulling effect on the oscillator. This is because no possible load effects on the output side of the coupler can affect the input side. Isolation is typically 10'' ohms in parallel with 1 pF at 1.5 kV.
2. The LED is a low impedance device when operated in the forward biased mode (normal operation) and several devices may be operated in parallel by a low power driver. This feature allows fan-out of the signal in a very simple manner.

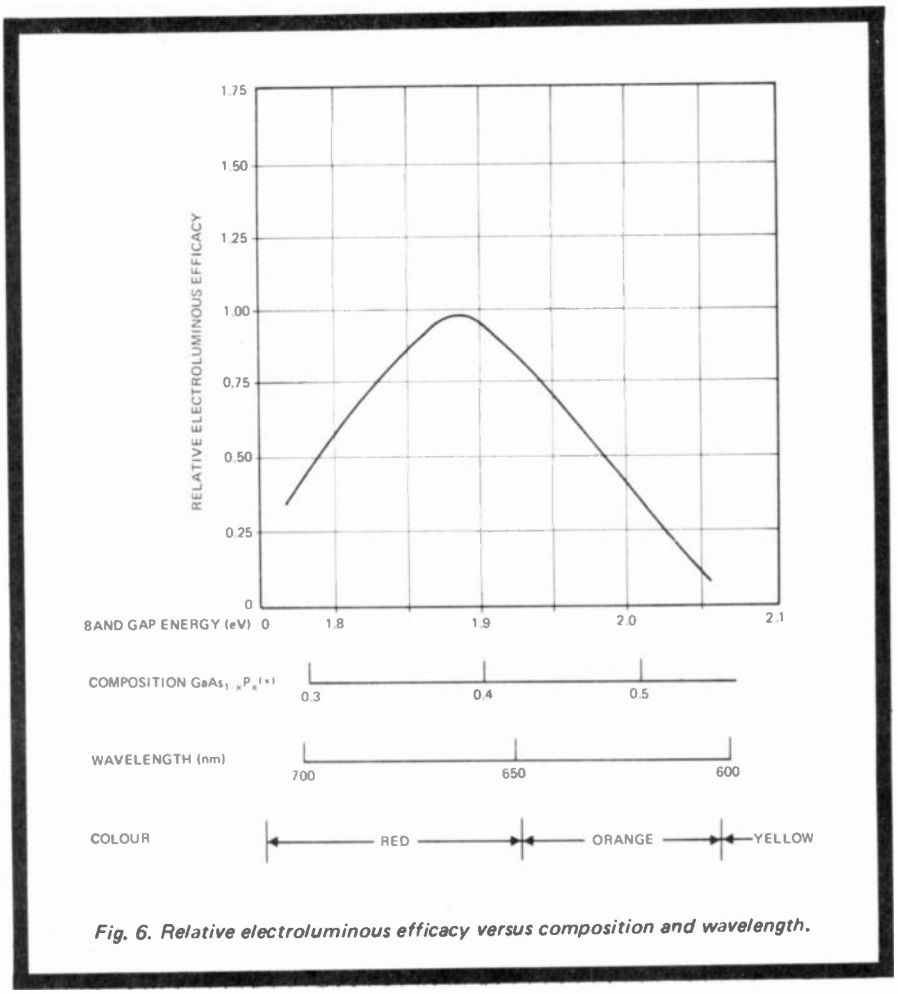

Fig. 6. Relative electroluminous efficacy versus composition and wavelength.

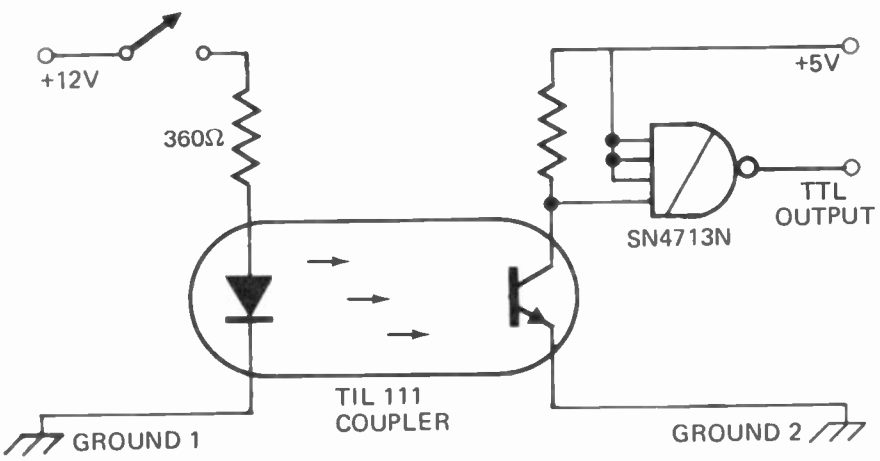

Fig. 7b. Here, an optical coupler interfaced between a microswitch and TTL logic is used to reject background noise.

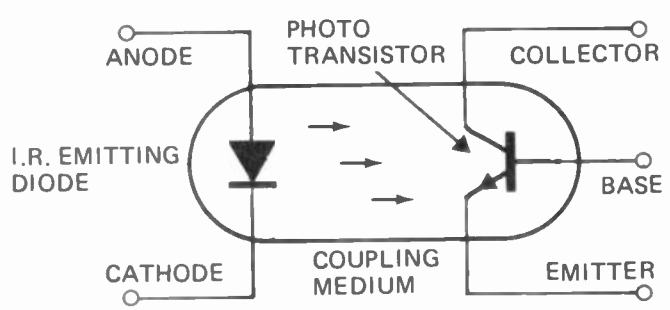

Fig. 7a. Basic construction of an optical coupler.

OPTO-ELECTRONICS

3. The LED coupler can be used to transfer signals between circuits having widely different supply voltage rails, whilst maintaining good linearity between input and output currents.

4. Due to the photon coupling there is no possibility of crosstalk between adjacent coupling channels.

5. They are high speed devices (several megahertz at least), have long life, are vibration resistant and are fully compatible with transistor and logic circuitry.

The configuration of the coupler is shown in Fig. 7a, and Fig. 7b shows a typical application of the TIL111 from Texas Instruments. Here the coupler is used to interface between a microswitch and TTL logic where the requirement is to isolate the logic from the ground noise associated with a microswitch circuit in an industrial environment.

Another important area of LED application is in alpha-numeric display panels as used in digital instruments. In many cases the count/decode electronics is integrated into the same 1C chip as the LED diodes. These displays will be discussed more fully in a later article. ●

GLOSSARY OF TERMS

Diffusion The process of adding impurities to a semiconductor material in order to affect its characteristics.

Epitaxial Growth The process of producing an additional crystal layer of semiconductor material on a semiconductor substrate. The crystalline structure of the substrate is continued into the epitaxial layer, however, the impurity concentration can be made to differ greatly.

Mesa Structure A diode whose structure is mound-like. During processing, material is etched away from the original chip in order to produce the final shape.

N-Type Refers to an excess of negative electrical charges in a semiconductor material. Natural silicon, which is an insulator, is made to be n-type, by the addition of a donor impurity.

P-Type Refers to an excess of positive electrical charges in a semiconductor material. Natural silicon is made to be p-type by the addition of an acceptor impurity.

Reactor A semiconductor processing device where epitaxial growth processes are carried out.

Lambertian An area source as opposed to a point source in light emission. Whereas radiation from a point source is equal in all directions, radiation from a Lambertian source is strongest in the direction of the normal to the surface and decreasing at angles from that normal.

Parallax An apparent displacement of an object when viewed from two different points.

Photons A quantum of light energy with energy hf, where h is Planck's constant, f is the light frequency.

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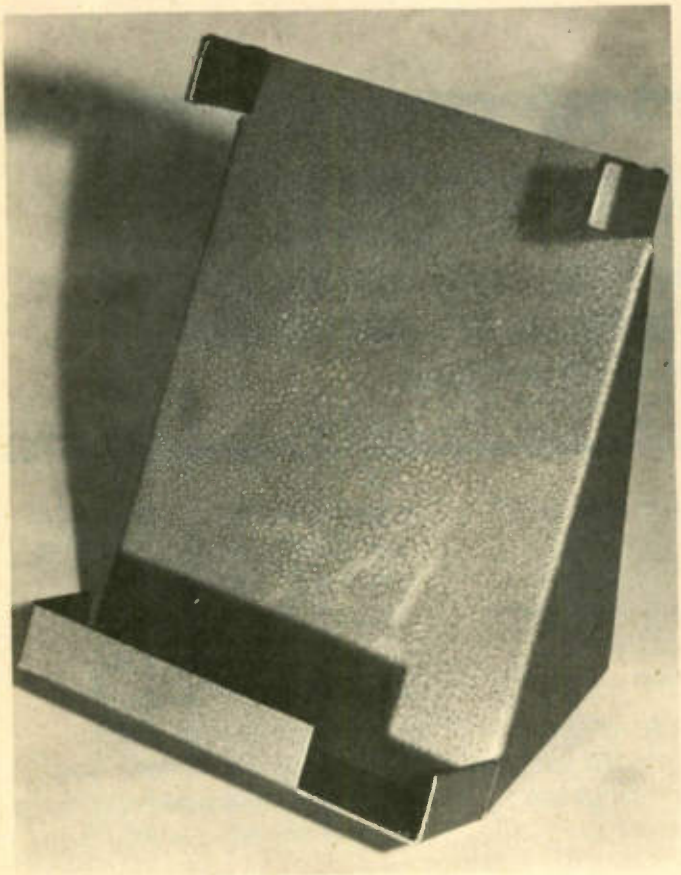
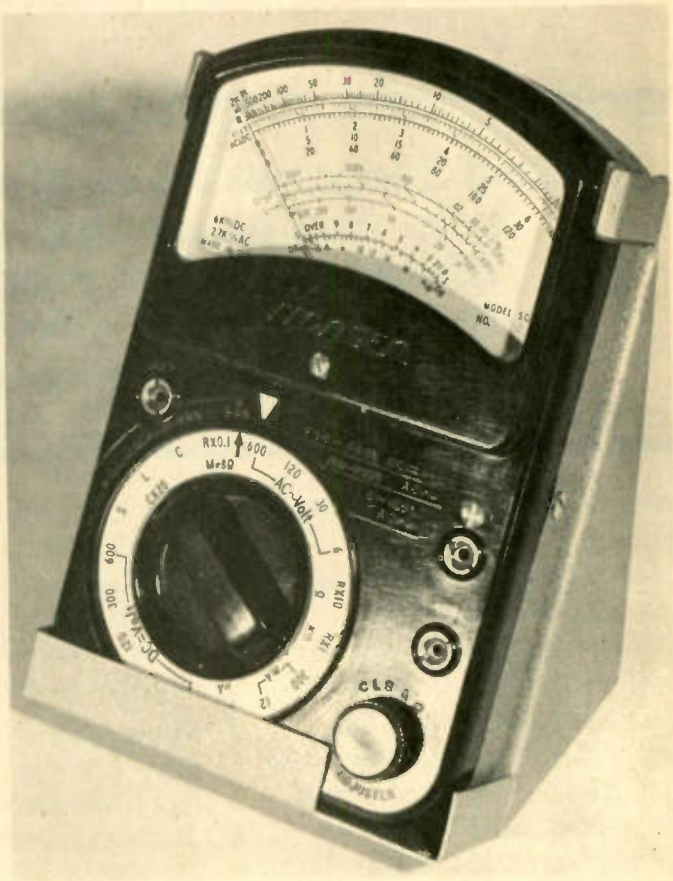
Simple yet effective, this meter stand takes only an hour or so to make.



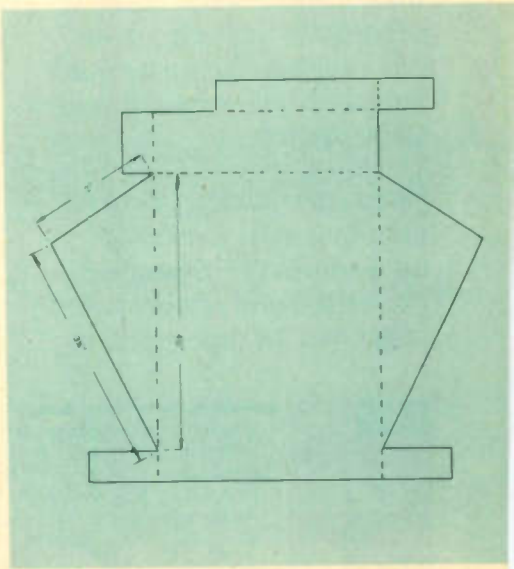


PROJECT 209

Here's a half-evening project well worth the trouble. This mount for a multimeter costs almost nothing and yet makes your meter more easily read whether you're sitting or standing. It gets rid of reflections from overhead lights, reduces bench space required and, to some extent, protects a meter from the occasional dropped tool, which glances off rather than penetrates.

The original was made for a meter measuring 3½" x 5½" from one piece of aluminium 7" x 6", cut to the shape shown in the drawing. No rivetting is required and all folds can easily be made in a vice. Full dimensions have not been shown as they have to be made suitable for individual meters. However, dimensions of the triangular sides are shown as a guide, as they determine the slope of the mount. These proportions should be retained for meters of all sizes.

The folds are along the dotted lines, and the direction of fold is clear from the finished mount. Provision for the ohms zero adjusting knob is made by leaving a cutout at the appropriate corner. The mount may be painted and lined with felt where thought necessary, to preclude scratching the meter. This is one of those 'why-didn't-I-think-of-it-before' gadgets. When you have it, you'll wonder how you did without it. Make one!



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Ranges: ± 199.9mV, 1.999V, 19.99V, 199.9V, 1199V
Accuracy: (1 year 15°C to 35°C) ± (0.1% of reading + 1 digit)
Input Impedance: 10 Megohms all ranges
Normal Mode Rejection: Greater than 60 dB @ 50Hz, 60 Hz
Common Mode Rejection: Greater than 120 dB @ dc and 50Hz, 60Hz
Maximum Input Voltage: 1200V rms all ranges

DC CURRENT

Ranges: ± 199.9uA, 1.999mA, 19.99mA, 199.9mA, 1999mA
Accuracy: (1 year 15°C to 35°C) ± (0.3% of reading + 1 digit)
Voltage Burden: 0.22V maximum up to 2 amps
Maximum Input: 2 Amps rms (fuse protected)

RESISTANCE

Ranges: 199,9Ω, 1.999KΩ, 19.99KΩ, 199.9KΩ, 1999KΩ, 1999MΩ
Accuracy: (1 year, 15°C to 35°C) All ranges except 20MΩ ± (0.2% of reading + 1 digit). 20MΩ range ± (0.5% of reading + 1 digit)

AC VOLTAGE

Ranges: ± 199.9mV, 1.999V, 19.99V, 199.9V, 1199V
Accuracy: (1 year, 15°C to 35°C) 45Hz to 10KHz ± (0.5% + 2 Digits). 10KHz to 20KHz ± (0.7% + 2 Digits)
Input Impedance: 10 megohms in parallel with 100 pf
Common Mode Rejection: Greater than 60dB @ 50Hz, 60Hz
Maximum Input Voltage: 1200V rms, not to exceed 10^7 volt. Hz product on 20,200, 1200V ranges. 500V rms on 200mV and 2V ranges.

AC CURRENT

Ranges: ± 199.9uA, 1.999mA, 19.99mA, 199.9mA, 1999mA
Accuracy: (1 year, 15°C to 35°C) 45Hz to 10KHz + (1.0% of reading + 2 digits)
Voltage Burden: 0.22V maximum up to 2 Amps

GENERAL:

Max. Common Mode Voltage: 1200V peak
Operating Temp. Range: –10°C to + 55°C
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1972 HI-FI AUDIO SHOW

WENDY ROY reports

Four-channel sound from the Akai 1730 D-SS tape deck coupled with the AA-6100 four-channel pre -main amplifier.

Decoration and demonstration supplied by the Marantz "Girl Friday", Sandra Hilliker.

THE opening movement of 'Thus spake Zarathustra' is always powerful. The 30 cycle notes convey Neitzche's idea of 'Superman' with strength and vigor, catching the imagination and the emotions. But when it is backed with equipment able to belt out the dramatic sounds of Richard Strauss in four-channel at several hundred watts per channel, the effect can be stunning, as visitors to the Hi-Fi Audio Show recently discovered.

This music, used of course by Stanley Kubrick in "2001 Space Odyssey", was also used by several exhibitors, particularly by Autel Systems who used all three media, disc, eight-track cartridge and reel-to-reel recordings of the music, with a patching system enabling a variety of equipment to be configured depending on the needs of the media.

The most effective of these combinations was a TEAC 3340 four-channel tape deck driving two Phase Linear amplifiers with an output of 700 watts 'rms' per channel via a PST1000 JCV pre-amplifier equaliser unit, feeding four ESS transmission line speakers capable of over 500 watts rms' each. This sound was so startling that it stopped many visitors in their tracks as soon as they entered the room.

There were other demonstrations of four-channel sound and most exhibiting companies had at least one product to introduce to the Australian market.

SAMPLE OF NEW PRODUCTS

A new selection of Marantz amplifiers released by Auriema (Australasia) Pty. Ltd., included the 1030 and the 1060 amplifiers. The 1030 model has an output of 15 watts

1972 HI-FI AUDIO SHOW

'rms', and the 1060 an output of 30 watts 'rms' per channel.

The nine-speaker Sigma System using the latest Plessey dome tweeter was designed in Australia for an overseas market. This was shown by Audioson International.

Latest from Expo International was the DSC 03 three-piece modular stereo cassette tape recorder with built-in amplifier and speaker boxes.

The Kenwood range from Jacoby Mitchell contained the KA6004 and the KA4004 amplifiers. The appearance of these two models was streamlined, with stainless steel front plates and new-style indicator lights. Another Kenwood item was the KL777 loudspeaker system with a box grille and bow line design. It is a four-way six-speaker system with a classical look about it.

The Akai GX1900 was another new model to the Australian market. A cassette/open reel transfer recorder, it combines the best of reel-to-reel and cassette systems in a vertical-standing unit. It uses the Akai GX head system, and can record from any input source as well as from the cassette section to the open reel and vice versa.

The AR Laboratory Standard Transducer speaker system from Acoustic Research was an integral part of the W.C. Wedderspoon Pty Ltd. demonstration. Overseas visitors and Australian audiophiles were suitably impressed with both the sound the price of this system (the price being around the $2,000 mark). At the other end of the scale, the SA800 amplifier demonstrated by Wedderspoon staff was priced at $250, handling 40 watts 'rms' with the added advantage of microphone mixing.

Two new speaker systems from Pioneer were displayed at the Astronics Australasia Pty Ltd. stand. These were the CS3000, a 12" three-way acoustical suspension system with dome mid-range and tweeter units, and the CSE450 ten inch two-way acoustical suspension system with a dome tweeter. Pioneer also introduced the CT4141 Dolby stereo cassette tape deck and the MU3000 direct drive turntable.

Among the four channel introductions, Hagemeyer Australasia brought into the country the JVC 5244 Nivico turntable. They also showed seven latest models of four-channel amplifiers. Sister-company, Haco Distributing Agencies, produced the SS2800 National three-piece modular unit which can be built into a four-speaker system with optional speakers. This model is able to play either CD4 discrete four-channel or matrixed programme material.

From Pioneer, the CT4141 cassette deck, with inbuilt Dolby noise reduction system.

INTRDDUCING C180

The longest cassette tape yet to be introduced to the cassette market anywhere was presented by Convoy International on behalf of TDK. This cassette tape runs for 180 minutes and Convoy have said they are looking forward to an even longer running cassette tape in the not-so-distant future.

Another tape innovation from Convoy was the TDK Extra Dynamic tape claimed by TDK to be as good as chromium dioxide without being as abrasive.

Three TEAC Dolby units, the AN180, AN50 and AN80, were shown by Convoy. These units fit any make of equipment and considerably reduce background hiss. The TEAC 3340 four-track tape recorder was also on display. With 'simil-sync' allowing the use of any of the four channels with microphone and line mixing, this recorder was described as almost professional.

Other equipment to catch the eye of the public included the Fisher XP55B speaker system demonstrated at the Magna Techtronic stand. These speakers measure 10" x 20" x 7½" and are claimed to produce as much volume of sound as speakers of greater size.

Among the display areas, the Sonab V1 pop-cube speakers added both colour and up-to-dateness,and the selection on the Bleakley Gray stand embraced all sections of interest, from the Sansui four-channel receiver amplifiers to the latest cassette deck.

Interesting new equipment was also found on the stands of Atram Pty. Ltd., Audio Engineers Pty Ltd., Audiosound Engineering Services Pty Ltd., BASF, Dodwell Trading Company, Fred A Falk (Sales) Pty Ltd., Godring Engineering (Australasia) Pty Ltd., Instrol Hi-Fi Centre, Jacoby Kempthorne Pty Ltd., Thorn Electrical Industries, AWA, and H.J. Leak.

We hope to review some of this equipment in future editions of Electronics Today International. ●

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Consumes current only whilst in use. Scope performs all the functions of other Irons from 40 to 150 Watts. (Miniscope—up to 75 Watts).

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Fast heating due to the unique replaceable carbon element. Only 5 to 6 seconds' initial heating up time from cold, then practically instantaneous.

VERSATILE
Copes with all soldering jobs—from miniature components to large solder lugs. Temperature control at your finger tips. Heat only when, where and as much as needed.

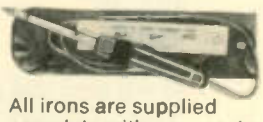
SAFE
Low voltage operation. Scope irons operate from 2.5V to 6V. Can even be operated from a 6 volt car battery. For convenience, safety and complete satisfaction use only the *Approved Scope Transformer—look for the name Scope.

*Approved by electricity authorities APP. No. N/360/6894-5

Fully guaranteed only when used with the approved "Scope" Transformer.

CONVENIENT
Ideal for those almost inaccessible spots. No burning of adjacent insulation.

LIGHT WEIGHT
Scope De Luxe weighs only 3½ ozs.
Miniscope 1¾ ozs.



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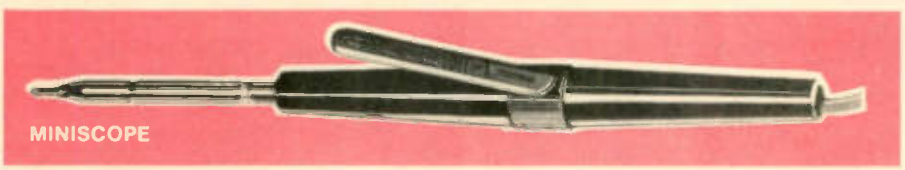

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ALEX ENCEL'S COLUMN

I've recently concluded reading a survey by Time Magazine Marketing Research into the American purchaser profile of audio systems, and while we don't know actual Australian figures to compare with the American ones, the U.S. figures are most interesting.

* * *

For instance, in a survey of 1198 people who had bought audio systems recently, 51% were buying for the first time. This seems quite incredible in a country as audio-sophisticated as the USA. The median price in these 1198 purchases was $298 — a price which very closely approximates our own.

* * *

Where did they buy? 70% of the buyers bought from a specialty audio store, with the other 30% spread among department stores, electrical mail order houses, disposals stores, and PX (the Army Post Exchange).

* * *

And the 5 major reasons for purchasing were: good prices (58%), desired equipment in store at the time (40%), reputation of the store (37%), knowledgeable salesmen (36%) and availability of service (29%). Being fairly modest, we feel that our own organisation fulfills the 5 major reasons — for American or Australian, people are people, and would probably give the same answers to the same questions.

* * *

The second point (availability of desired equipment at the time) is the reason why good audio stores throughout the world carry such a wide range of alternative components, and why specialist audio stores are attracting the customers. You can't suit everyone with the same items. You may as well go to a clothing store that only offers three colours of suits.

* * *

We're offering special deals on world-famous Tandberg taperecorders, notably the 3000XStereo Tape deck. List price is $464, discount price $418.50. ENCEL PRICE $298.

If you don't know the specifications of the Tandbergs, call in and listen, or talk to our specialists.

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ADC 220X . . $17.00

ADC 220X. Type: Induced Magnet; **Output:** 6 mV at 5.5 cms / sec. recorded velocity; **Tracking Force:** 1 to 2½ grams; **Frequency Response:** 10 Hz to 18 kHz +3dB; **Channel Separation:** 20dB from 50 Hz to 10 kHz; **Compliance:** 20 x 10^{-6} cms/dyne; **Spherical Stylus Tip Radius:** 0007" **Vertical Tracking Angle:** 15°.

ADC 10E mk4 . . . $51.00

Type: Induced Magnet*
Output: 4 mV at 5.5 cms / sec. recorded velocity
Tracking Force: .7 gram
Frequency Response: 10 Hz to 20 kHz ± 2 dB
Channel Separation: 30 dB from 50 Hz to 12kHz
Compliance: 35 x 10^{-6} cms / dyne
Elliptical Stylus Tip: Contact radius: .0003"; lateral radius: .0007"
IM Distortion: Less than ½"% – 400 & 4000 Hz at 14.3 cms / sec. recorded velocity
Vertical Tracking Angle: 15 degrees
Recommended Load Impedance: 47000 ohms nominal

ADC 220XE . . . $22.00

ADC 220XE. Type: Induced Magnet; **Output:** 6 mV at 5.5 cms / sec. recorded velocity; **Tracking Force:** 1 to 2½ grams; **Frequency Response:** 10 Hz to 18 kHz ± 3 dB; **Channel Separation:** 20 dB from 50 Hz to 10kHz; **Compliance:** 20 x 10^{-6} cms / dyne; **Elliptical Stylus Tip Radii:** Contact radius .0003". Lateral radius .0007"; **Vertical Tracking Angle:** 15°

ADC 550XE . . . $30.00

ADC 550XE. Type: Induced Magnet; **Output:** 5 mV at 5.5 cms / sec. recorded velocity; **Tracking Force:** ¾ to 2 grams; **Frequency Response:** 10 Hz to 20 kHz ± 2 dB; **Channel Separation:** 20 dB from 50 Hz to 12 kHz; **Compliance:** 35 x 10^{-6} cms / dyne; **Elliptical Stylus Tip Radii:** Contact radius .0003". Lateral radius .0007"; **Vertical Tracking Angle:** 15°.

SPECIAL INTRODUCTORY ADC OFFER . . . SAVE $ $ $ $

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(D) INSTROL 44 STAND PLUS HINGED 'PERSPEX' COVER.	This acoustically sprung player stand is available in either oiled teak or walnut, complete with moulded perspex cover and "stay-up" hinges.

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Please send me your complete hi-fi catalogue and price list. I enclose herewith postage stamps or money order to the value of 50c. I understand that the 50c will be refunded on my first purchase.

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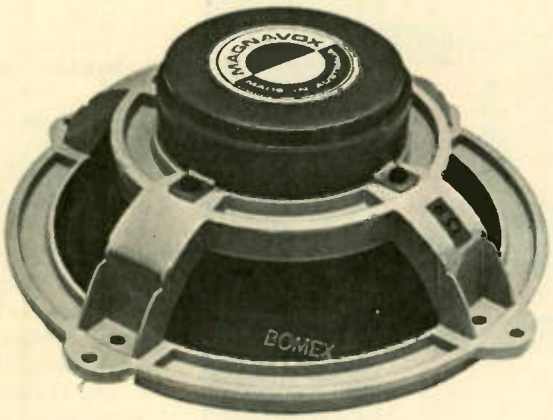
T210

INSTROL SPEAKER SYSTEMS

All the systems below are available in kit form. The cabinet kits come in either unpolished Queensland Maple veneer of unpolished teak veneer. All kits are complete, and include speakers, crossover networks (where applicable), cabinet kits, grille cloth and innerbond.

MAGNAVOX 8-30 SYSTEM

at reduced prices.



Featured in "Electronics Today". It handles 30 watts RMS, features a new high performance 8" speaker, two 3" tweeters, and is available in cabinet 20 7/8" x 12 7/8" x 8 7/8" (1 cu. ft.) or 23 7/8" x 15½" x 10 7/8" (1.6 cu.ft.). Available in teak or walnut veneer.

COMPLETE SYSTEM

Kit of Parts	$42.00(1cu ft), $52.00 (1.6 cu ft)
Built and Tested	$55.00 (1 cu ft), $65.00 (1.6 cu ft)

SEPARATE COMPONENTS

Enclosure kit (1 cu ft)	$16.50 (maple), $17.50 (teak)
Enclosure kit (1.6 cu ft)	$26.00 (maple), $28.00 (teak)
Built Enclosure (1 cu ft)	$29.00 (walnut), $30.00 (teak)
Built Enclosure (1.6 cu ft)	$38.00 (Walnut), $40.00 (teak)
speakers & crossover only	$26.00 (one side only)

NEW E.T. MAGNAVOX 8-30 DESIGN

A revised version of the popular Magnavox system was featured in July 1972 edition of Electronics Today. It featured a Philips tweeter and improved crossover

COMPLETE SYSTEM

Kit of Parts	$62.00 (1 cu. ft.) $72.00 (1.6 cu. ft.)
Built and Tested	$75.00 (1 cu. ft.) $85.00 (1.6 cu. ft.)

SEPARATE COMPONENTS

Speakers and crossover only	$45.00 (one side only)

WHARFEDALE SPEAKER SYSTEM KITS

The Wharfedale Super Linton, Melton and Doverdale III are now available as build-yourself kits, featuring INSTROL quality cabinet kits in choice of maple or teak veneer.
The Super Linton kit employs an 8" and 3" speaker, frequency response 40-17,000Hz, cabinet 21" x 11½" x9½", 15 watts RMS.
The Melton kit employs a 12" bass and a tweeter, cabinet 22¾" x 13" x 10", 25 watts RMS.
The Dovedale III kit employs a 12" bass, 5" mid-range and 1" tweeter. Cabinet 28" x 15½" x 10", 35 watts RMS.

COMPLETE SYSTEM

Super Linton kit (Unit 3)	$52.00
Melton kit (Unit 4)	$93.00
Dovedale III kit (Unit 5)	$127.00

SEPARATE COMPONENTS

Unit 3 encl. kit	$15.50 (maple), $16.00 (teak)
Unit 4 encl. kit	$26.00 (maple), $28.00 (teak)
Unit 5 encl. kit	$35.00 (maple), $37.00 (teak)

INSTROL and SEAS COMBINE to present 2 NEW speaker systems the BROADWAY 201 and BROADWAY 251

BROADWAY 201 — This system features the SEAS wide range 8" speaker, 21TV.GD, in your choice of teak or walnut enclosure. The attractive cabinets, which feature bevilled fronts, measure 16-7/8" x 11" x 9".

BROADWAY 251 — This system uses the 25 TV.ED, a 10" wide range speaker by SEAS, in teak or walnut cabinets. Featuring bevilled fronts, the enclosures measure 21" x 12" z 11½".

COMPLETE SYSTEM

Kit of Parts (Broadway 201)	$26.00
Kit of Parts (Broadway 251)	$33.00
Built and Tested (Broadway 201)	$36.00
Built and Tested (Broadway 251)	$46.00

SEPARATE COMPONENTS

BROADWAY 201 encl. kit only	$14.00 (walnut) $15.00 (teak)
Broadway 251 encl. kit only	$19.00 (walnut) $19.50 (teak)
8" SEAS (21 TV.GD) speaker only	$12.50
10" SEAS (25 TV.ED) speaker only	$14.50

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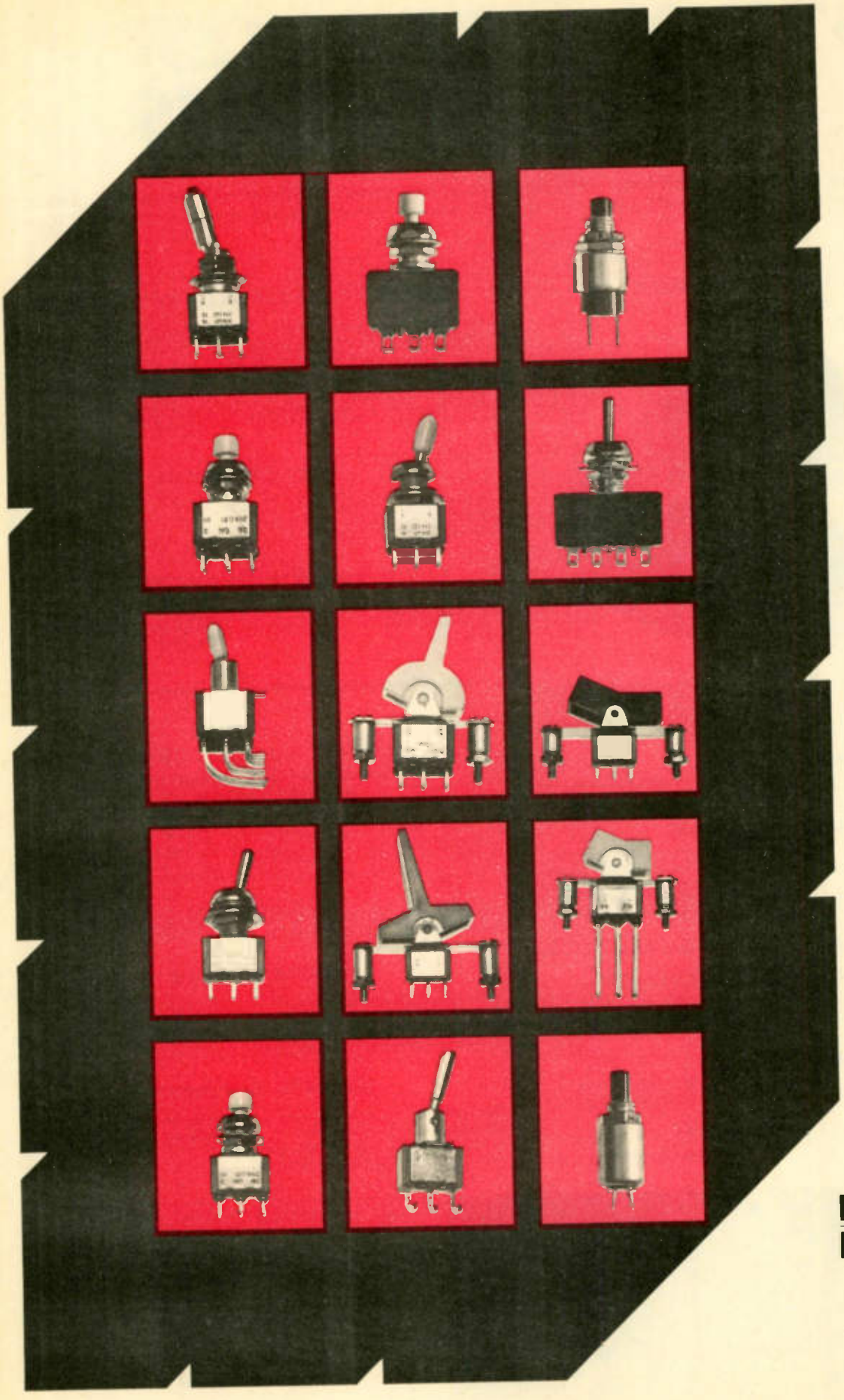
T210



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PART IX

Antennae design and construction

OBSERVATIONS over the range 10 MHz to 30 MHz are usually limited to recording the radiations of the Sun and Jupiter. Large arrays having high gain and narrow beam widths are very unwieldy at these frequencies and because of this some design compromises must be accepted.

Fixed antenna installations are used in drift radiometers where the rotation of the earth carries the antenna beam past the cosmic noise sources. This is obviously the most practical arrangement for observations in the HF Spectrum.

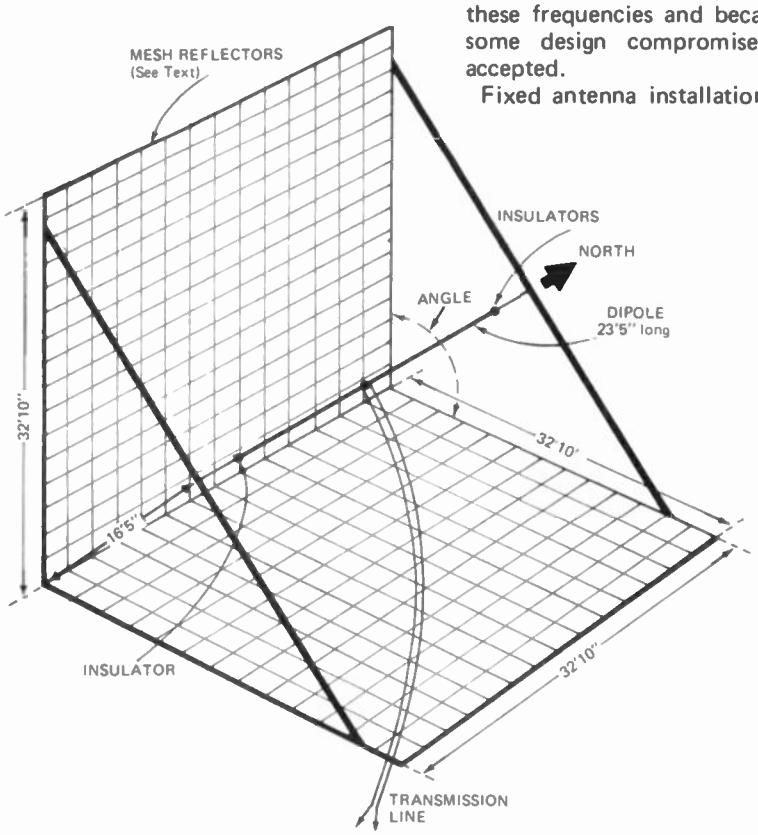

Fig. 1. 20 MHz Corner Reflector Antenna.

A very useful, and relatively versatile, antenna — the corner reflector — is shown in Fig 1. If you have the space available, this antenna can readily be set up in a back yard. A timber framework is perhaps the best — certainly the cheapest — form of construction on which the mesh reflectors can be mounted. One reflector can lie flat on the ground, the whole structure being oriented as shown. The angle between the two reflectors may be 90° or 60°, the latter angle giving slightly more gain.

The mesh may be chicken wire of either large or small mesh or fly-wire gauze — the copper variety is best. Alternatively you can make your own by stretching a grid of wires across the frame and carefully soldering all the joints.

Anchor the mesh securely to the frame with insulated staples to prevent movement as metal rubbing against metal in the antenna structure causes spurious noises in the receiver.

The dipole can be arranged so that it may be replaced by others for different frequencies. At 30 MHz, two half-wave dipoles, connected in phase, are only 31'2" long and will fit across the frame quite well. If you use coaxial transmission line to feed the dipole a balun transformer will be necessary. These can be obtained quite readily from various commercial sources or you can make your own. I will deal with this in a separate section later.

The "All-sky" antenna illustrated in Fig. 2 is very easily constructed, but the mesh reflector takes up quite a lot of ground space. It should be at least 0.7 wavelengths square at the frequency in use (33ft at 20 MHz) — preferably one wavelength square (47ft at 20 MHz). It may be buried in the ground if space is at a premium. If you live on the side of a hill — don't despair — it just means that the antenna pattern will be directed at an angle other than the zenith (i.e. straight up) dependent on the slope of the land.

It is called an All-Sky antenna because its radiation pattern is a very broad lobe aimed straight up.

The mesh reflector, as for the corner reflector antenna, may be chicken wire, copper fly screen or a homemade mesh. Don't worry too much about its flatness, providing no bumps or

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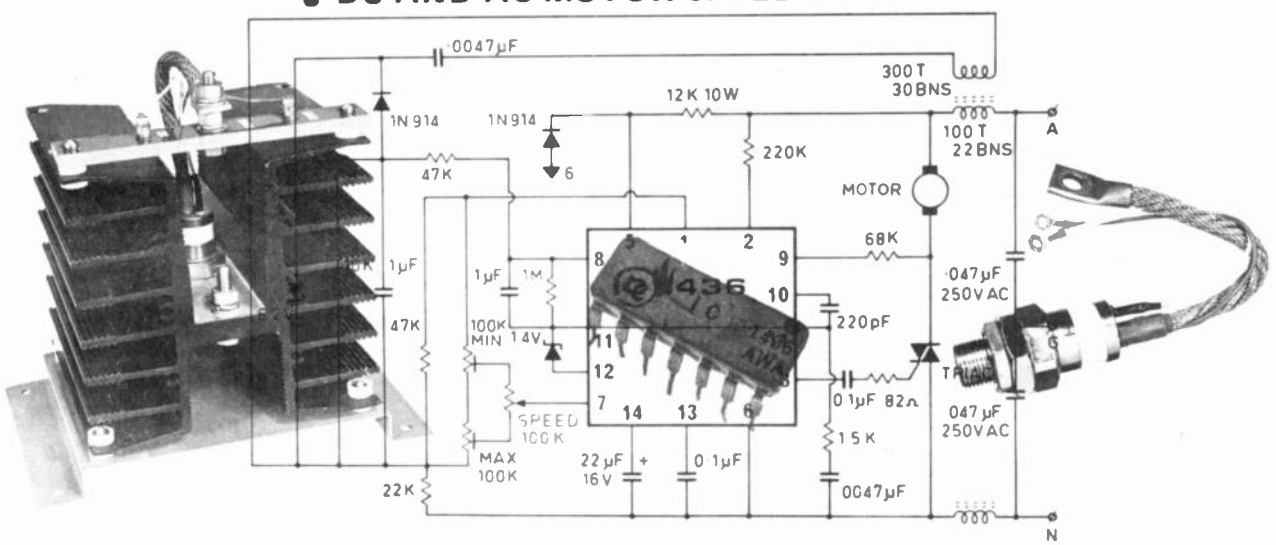

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RADIO ASTRONOMY FOR AMATEURS

anomalies greater than the order of 1/8 wavelength occur.

Again, the dipoles may be made interchangeable so that the antenna system is relatively flexible.

The simplicity and ruggedness of this design are its greatest advantages.

SPIRAL ANTENNA

The wideband log-periodic spiral is a very versatile and easily constructed antenna. It takes the form illustrated in Fig. 3. Basically it can be described as a transmission line that is wound in a circular fashion such that the radius increases at a logarithmic rate. Ideally it should form a smooth logarithmic spiral but this is difficult if not impossible to achieve in practice and not really necessary. It can be constructed to work over a range of at least 10:1. Its gain and directivity is good at the upper end of its range, decreasing with frequency. It has the advantage that it very severely attenuates signals arriving at low angles, thus reducing interference. It is circularly polarised, the sense of polarisation being dependant on which way the spiral turns.

As most people will have different interests and needs for such an antenna, I will provide design information only.

The spiral is described by the equation — $R(n) = b \times e^{n/a}$

Where R (n) = Radius at radial crossing point "n"

n = the number of the radial crossing point

b = initial diameter (half wave length at highest frequency)

a = constant worked out knowing the final diameter, the number of turns and radials (and thus the number of radial crossing points) and the initial diameter.

Final diameter = half wavelength at lowest frequency.

The number of radials shown in Fig 3. is only six and is the minimum number I would recommend.

To design this antenna firstly decide on the frequency range you wish to cover. This determines the final and initial diameters. The number of turns or revolution influences the gain and directivity — more turns, more gain etc. — the minimum number of turns being governed by the ratio of maximum to minimum frequency. The higher the ratio, the more turns are needed. A rough rule of thumb is to divide the max-min. frequency ratio by two. Next, decide on the number of radials you think necessary. Six are easily erected but more will be necessary if a really wide frequency range is covered. The number of radials and number of revolutions then automatically sets the number of radial crossing points. A handy convention for numbering the radial crossing points is shown in Fig. 3 (b). The total number of radial crossing points equals the number of radials multiplied by the revolutions. Substitute the values for the final diameter (R(n) at n= last crossing point), initial diameter b and number of radial crossing points to find the value of a. It is then a simple matter to work out the radius for each radial crossing point.

Construction is very simple. Set out a number of posts in the ground as shown in Fig. 3a. The lengths of the posts should be such that when erected the tops should be above head level. (Unless you want to strangle yourself in the dark).

Next make up a grid of cotton hemp rope or string (nylon stretches too much and is unsuitable) in the manner shown in Fig 3a. Mark out the radii for the two arms separately. This is probably best done on the ground.

Erect the radials and then construct each arm of the antenna using hookup wire, coil wire or what-have-you. Very thin wire does not work as well as heavy gauge or stranded wire. Make sure the radials can support the weight if a very heavy gauge is used.

The dipole in the centre may be a wire arrangement or made out of

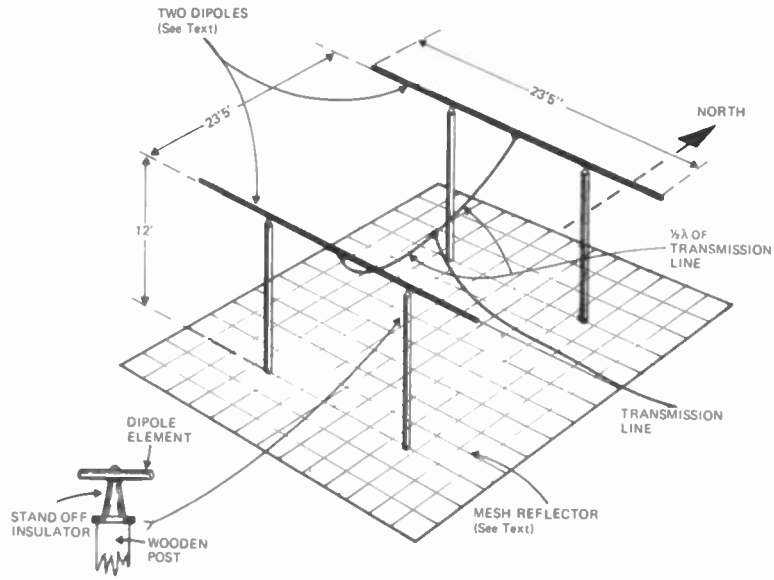


Fig. 2. 20 MHz "All-Sky" Antenna

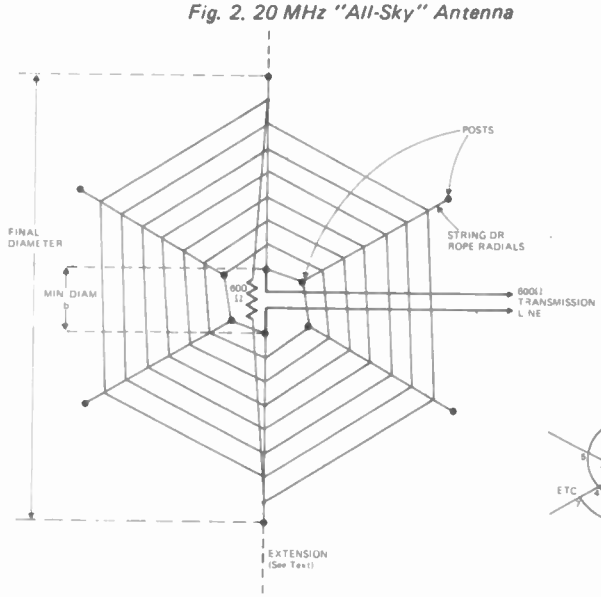


Fig. 3a. Wideband Log-Periodic Spiral.

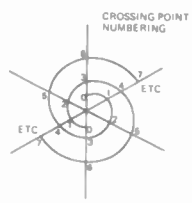


Fig. 3b.

RADIO ASTRONOMY FOR AMATEURS

tubing. It must be fed with a 600 ohm open wire transmission line or a balun transformer and coaxial cable.

The ends of the arms are brought back to the centre and terminated with a 600 ohm resistor (560 ohm or 680 ohm would be close enough for this application).

If you don't wish to mount it above head level it may be mounted lower, but I would recommend that it be placed no lower than three feet from the ground.

The lower frequency may be extended by taking the ends out as extensions of a dipole (as shown in Fig 3a.) Performance is still good at the lower frequencies but deteriorates from that for the unextended spiral.

The three fixed antennas I have just described are probably the ones most suited to the average person constructing a radio telescope. The cost is low, construction is relatively easy and they can be fitted into the average suburban back garden.

ROTATABLE ANTENNAE

Rotatable antennas have obvious advantages over the fixed variety, and must be used for certain specific applications, particularly if tracking of the sun is required.

A simple wood-and-wire construction antenna is shown in Fig. 4, it can be automatically rotated if you wish. The mechanical details are not included here as individual situations and requirements more or less dictate how to do it. It can be simply made into a solar mount if desired — details on this later.

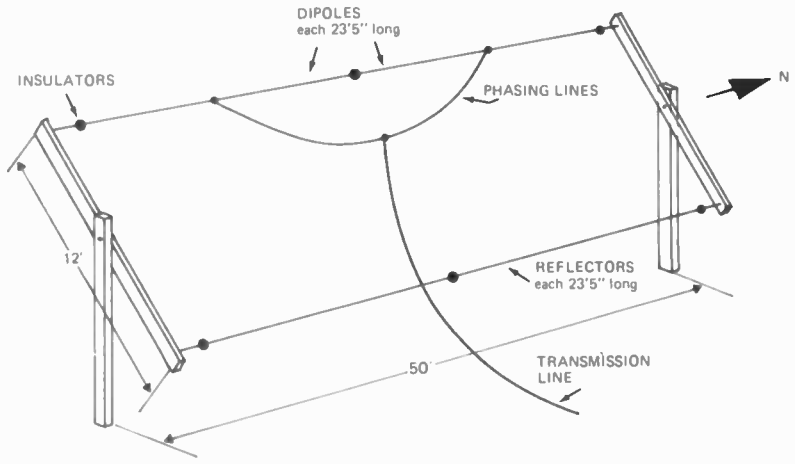


Fig. 4. Steerable two half-waves in phase for 20MHz.

This antenna can be made for other frequencies, the formulae for which can be found in most antenna handbooks or "The Radio Communication Handbook" by the RSGB or "The Radio Amateurs Handbook" by the ARRL.

The dipoles will have to be fed with balanced line or coax. and baluns. I recommend using coxial cable.

Probably the most popular rotating antenna is the Yagi. It is best fed with co-axial cable. (My God — how much does it eat? -Ed.) To do this, a popular method is to use the gamma match. The gamma match rod should be about three feet long. The matching should be adjusted using a signal generator and impedance bridge. (Fig. 5).

A folded dipole and "trombone" transformer matching is a better arrangement but somewhat more complex mechanically. Also, the tuning capacitor has to be completely weather protected.

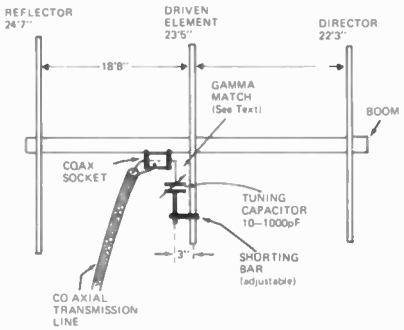
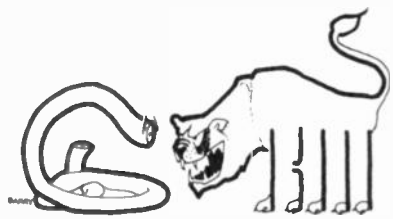


Fig. 5. 20MHz three-element Yagi.

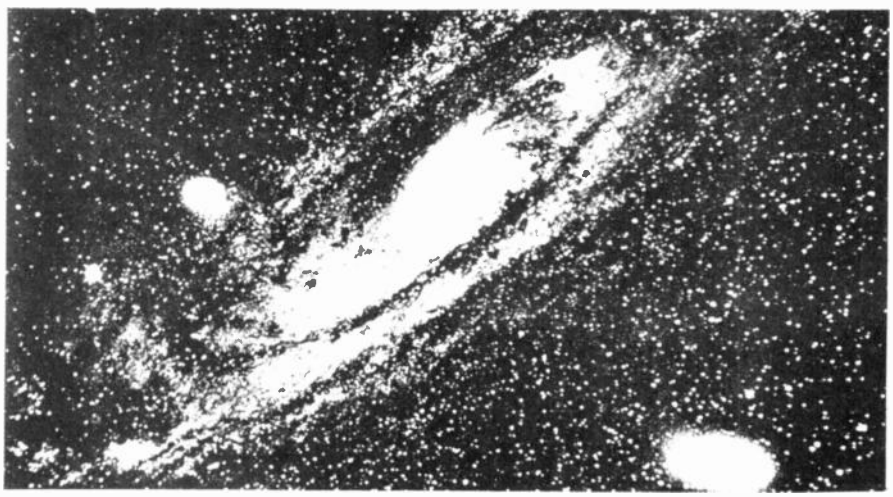


"Probably the most popular rotating antenna is the Yagi. It is best fed with co-axial cable."

The Yagi is best constructed out of tubing. A variety of methods are illustrated in the above-mentioned handbooks as well as "The Antenna Handbook" by the ARRL.

It can be mounted so that its pattern passes through the zenith or, alternatively, mounted on a polar mount — details of which will be given shortly.

To be continued . . . ●



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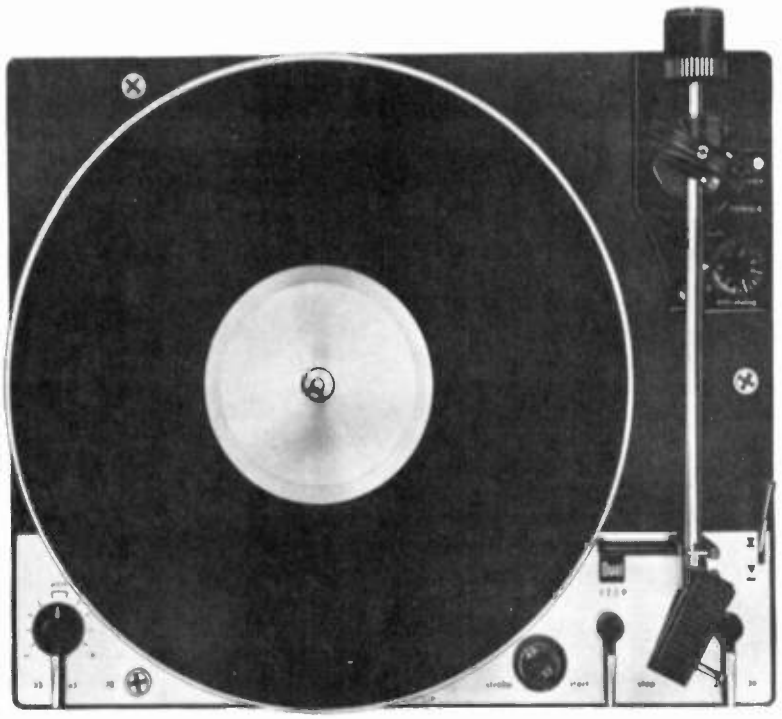

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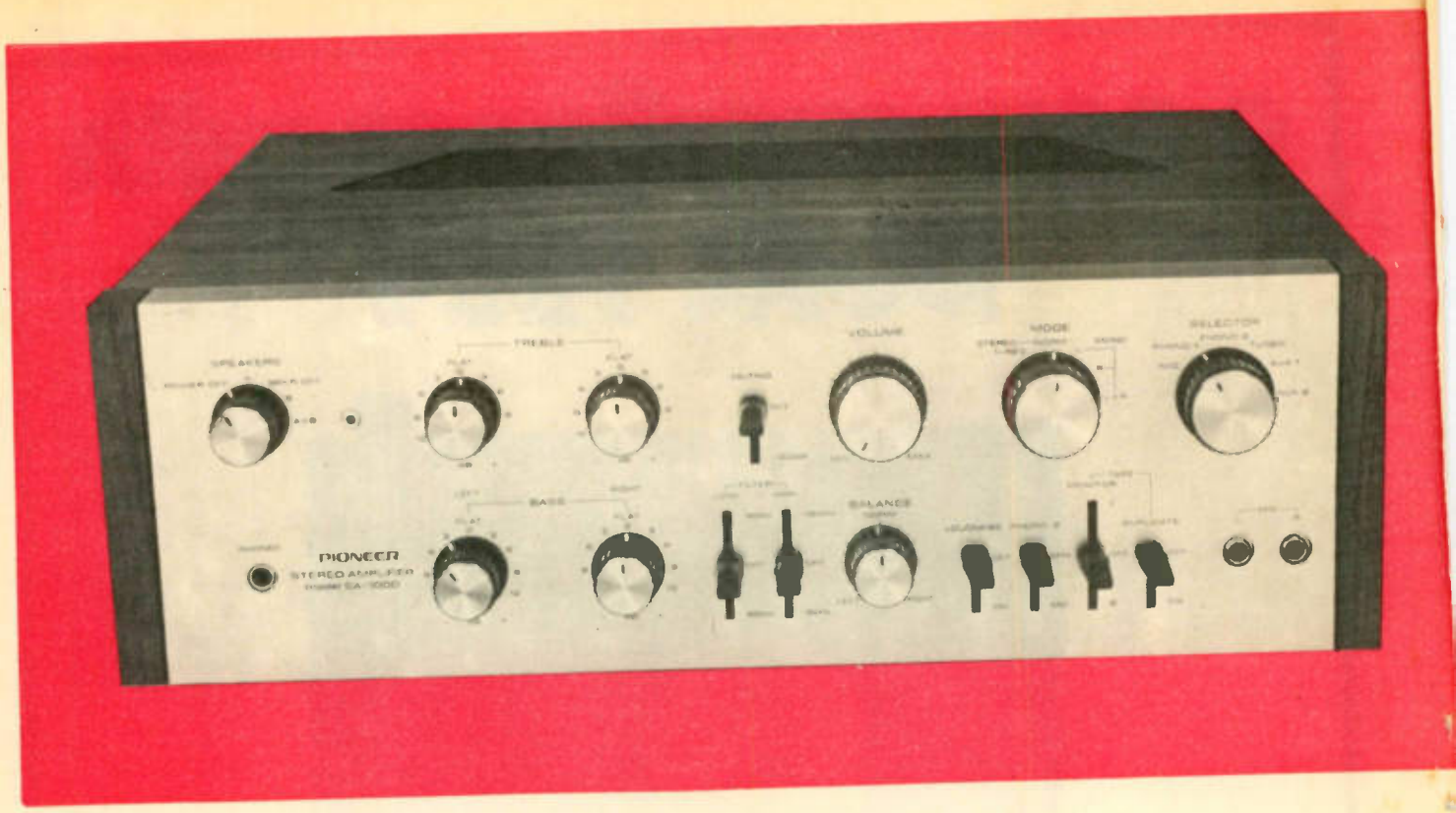


PIONEER SA 1000 AMPLIFIER

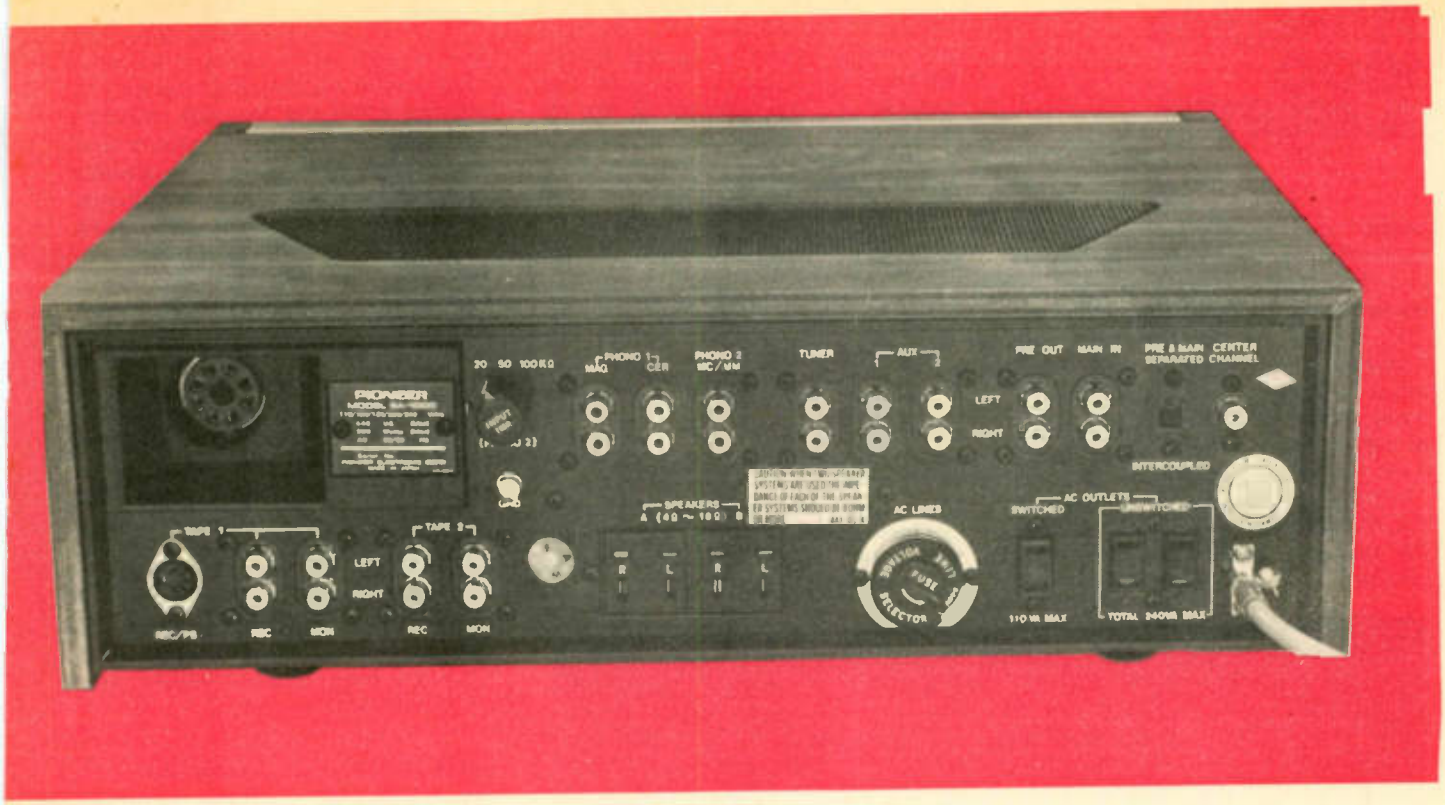
Versatile high-power amplifier is good value for money.

electronics TODAY INTERNATIONAL product test

JAPAN'S Pioneer Corporation started as a rather small speaker manufacturing concern, known as the Fukuin Electric Works, in 1938. It now has four large divisions, manufacturing audio equipment, speakers, car stereos and recording instruments.

The Pioneer SA 1000 is one of the most recent additions to the company's amplifier range and incorporates some of the most recent "state of the art" circuitry. It has many design improvements over the SA 900 which was previously Pioneer's top amplifier.

The unit arrived adequately packed in moulded expanded polystyrene enclosed in a cardboard box. Once unpacked we were confronted with a complex array of switches and control knobs on the front panel and what appeared to be, at first sight, an infinite array of input and output sockets on the rear panel; without doubt the SA 1000 stereo preamplifier/main amplifier has one of the most comprehensive sets of controls and switching facilities that we have seen to date. The front panel



is smoked, brushed, aluminium with polished timber end trim and contains two horizontal rows of controls. The top row of controls have the following functions – from left to right:–

a) Speaker-select knob with five positions; power off, speakers 'A' speakers off, speakers 'B' and speakers 'A' and 'B'.

b) Treble control left channel with three 3dB per step boost positions and four 3dB step cut positions.

c) Treble control right channel with three 3dB per step boost positions and four 3dB per step cut positions.

d) Muting switch with off and 20dB cut positions.

e) Volume control.

f) Mode select switch with five positions; stereo reverse, stereo normal, mono left, mono right and mono left plus right.

g) Programme source selector switch with six positions; microphone, phono 1, phono 2, tuner, auxiliary 1, auxiliary 2.

On the bottom row we have, from left to right:–

i) Headphone jack socket.

ii) Bass control left channel with four 3dB per step boost positions and three 3dB per step cut positions.

iii) Low filter select switch with three positions up – 30Hz filter; centre – off; down – 60Hz filter.

iv) High filter select switch with three positions up – 12kHz filter; centre – off; down – 6kHz filter.

v) Balance control.

vi) Loudness switch, with on and off position.

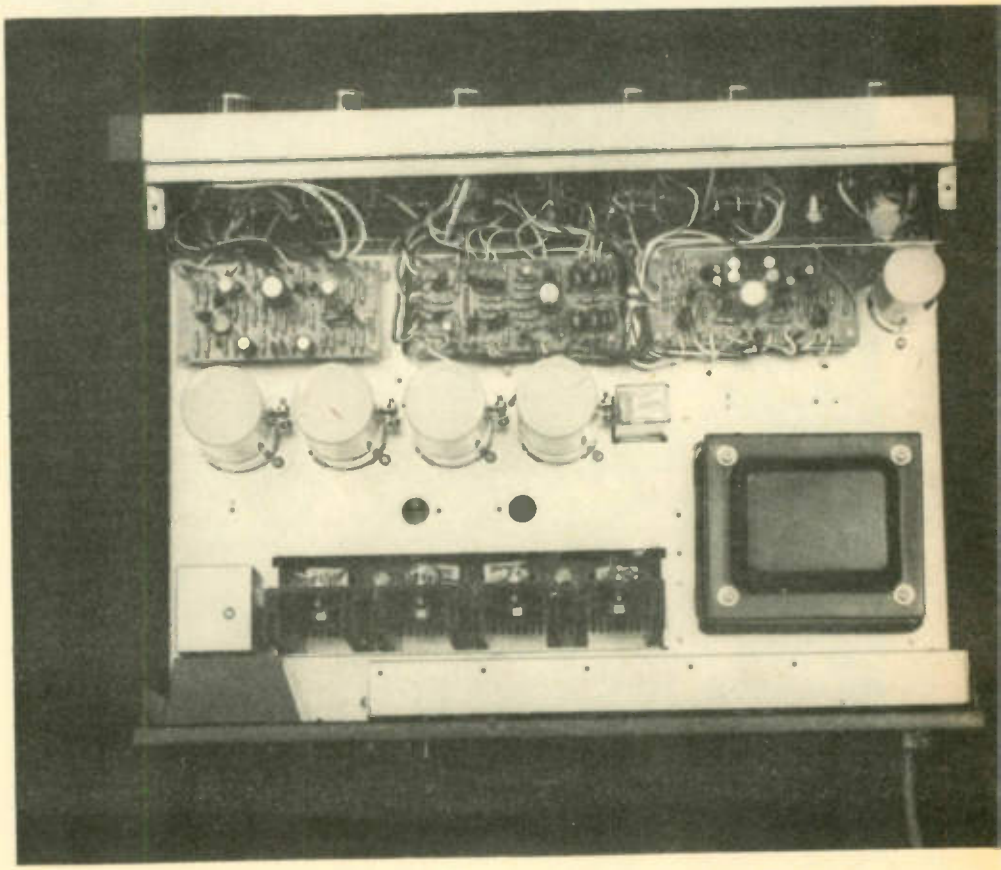
vii) Phono 2 cartridge type select switch with two positions; moving coil and moving magnet.

viii) Tape monitor switch with three positions; up, tape 1 monitor, centre, 'off', and down tape 2 monitor.

ix) Tape duplicate switch with 'on' and 'off' position.

x) Two microphone input jacks.

All input and output sockets are



PIONEER SA 1000 AMPLIFIER

located on the rear panel with the exception of the microphone inputs and headphone output as detailed above. Pairs of R.C.A. sockets are used for:– Phone 1 magnetic input, Phone 1 ceramic input, Phono 2 input, tuner input, auxiliary 1 input, auxiliary 2 input, preamplifier out, main amplifier in, tape 1 record, tape 1 monitor, tape 2 record and tape 2 monitor.

Centre channel output is via a single R.C.A. socket at the right hand end. To facilitate connection of a tape recorder with a combination DIN record playback lead, a DIN socket is included in addition to the R.C.A. sockets for Tape 1. Outputs for speakers 'A' and speakers 'B' are via polarized two pin sockets grouped in pairs. Three 2 pin American type power outlets are also provided on the rear panel, one switched, the other two unswitched. Other features of the rear panel include:–

a) A multipin valve-base socket into which a phono transformer plugs for moving coil cartridges.

b) A phono 2 input impedance select knob with 20kΩ 50kΩ and 100kΩ positions.

c) A pre-amplifier, main amplifier isolation switch.

d) A multipin fuse holder which doubles as a mains voltage selector with 'off', 110V, 120V, 130V, 220V, and 240V positions.

MEASURED PERFORMANCE OF PIONEER SA 1000 AMPLIFIER SERIAL NO

Power Output Into 8Ω Load At Rated Input (both channels driven)		65W
Frequency Response At Rated Output 20 to 20kHz		± ½dB
Channel Separation At Rated Output		
Phono Input		45dB
Auxiliary Input		50dB
Hum And Noise Unweighted With Respect To Rated Power Volume Control At Minimum Gain		
Phono Input		84dB
Auxiliary Input		94dB
Total Harmonic Distortion At Rated Output		
100Hz		0.25%
1kHz		0.2%
6.3kHz		0.2%
Tone Controls		
Bass	– boost at 50Hz	14dB
	cut at 50Hz	12dB
Treble	– boost at 10kHz	7dB
	cut at 10kHz	11dB
Filters		
30Hz	(at 30Hz)	–3dB
60Hz	(at 60Hz)	–2.5dB
6kHz	(at 6kHz)	–3dB
12kHz	(at 12kHz)	–3dB
Loudness		
	boost at 50Hz	11dB
	boost at 10kHz	4dB
Mute Control	at 1kHz	19.5dB
Dimensions 16-15/16" wide x 5-11/16" high x 13-1/4" deep.		
Weight		28lbs
Price		$430

The top and side panels are oiled walnut and may be removed for flush mounting of the amplifier and for this purpose a full size template, showing shelf and front panel cutouts and fixing screw centres, is also supplied.

One function which warrants particular attention is the tape duplicate switch. When the switch is in the "on" position it is possible to transfer from tape 1 to tape 2 or tape 2 to tape 1 without affecting the normal operation of the amplifier via the modes available on the selector switch. For instance, it is possible to listen to a record in the normal fashion whilst the dubbing is in process and to interrupt the record to check the dubbing process by operating the tape monitor switch without affecting the recording being made. The monitor switch will either monitor the signal off the master tape or the signal off the just recorded tape, assuming the recorders have separate record and playback heads.

THE ELECTRONIC CIRCUITRY

The circuitry consists of five sections, each on their own individual printed circuit boards plus a power supply printed circuit board.

The first board in the system is a preamplifier for phono 1, phono 2 and microphone inputs.

This board is followed by the main preamplifier which includes treble and bass tone control circuits, This circuit incorporates a FET in the input stage to eliminate switching transients from the stepped tone controls. The SA 900 amplifier, which was previously the most powerful amplifier of the Pioneer range, was well known for the clicks which its stepped tone controls produced. The SA 1000, by contrast, shows no sign of this, even at maximum power levels.

The third board contains the filters and the loudness control circuitry. The second last board is the power amplifier stage. This is directly coupled and drives the speakers via protection circuits.

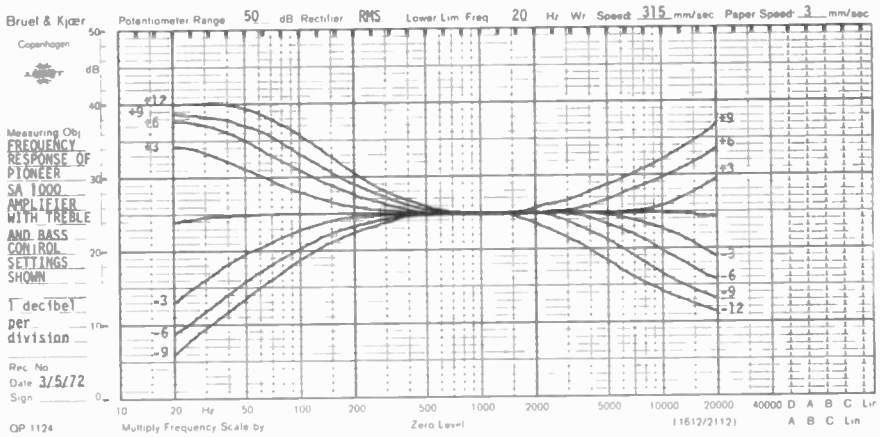
The circuitry used in the main amplifier and protection circuit is rather ingenious. The input to the main amplifier drives one leg of a long tail pair, the other leg of which is in a feed-back-loop from the output. This arrangement very effectively reduces the inherent distortion produced by the quasi-complementary output stage. To balance the collectors of the long tail pair, a transistor load is placed into the collector of the feedback transistor. The protector circuit (which uses seven transistors) senses three main conditions; abnormally high temperatures on the heat sinks, the dc level at the speaker outputs, and excessive voltage at the output of

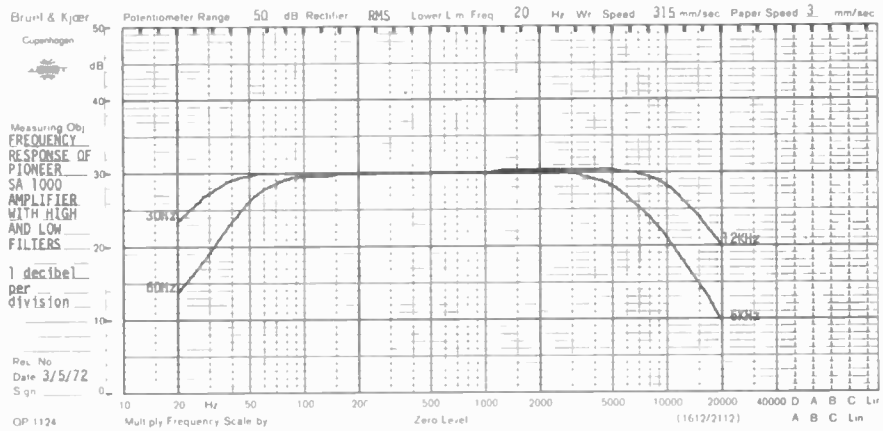
the power transistors. The output power is also limited to 100 watts maximum when driving an 8 ohm load due to clipping in the output stage.

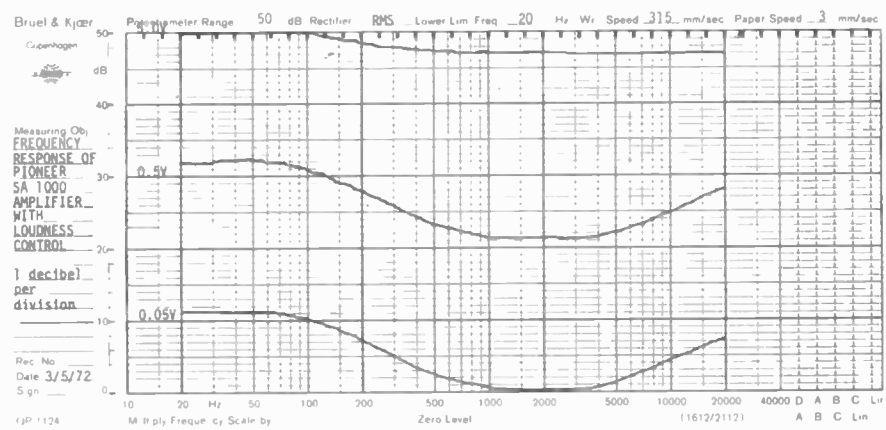
If a fault occurs it is possible to hear the relay switching in and out – checking the condition every couple of seconds until the fault is removed – whereupon it restores normal operation. This does not produce any thump at the speakers. When the amplifier is switched on, this circuit takes about three seconds to operate. Thus no switching transients are heard.

The dc sensing circuit protects the speaker coils against possible overheating and resultant damage. The unit tested was subjected to short circuited outputs and 12V overloads on the auxiliary's inputs over a period of three hours without any resultant damage.

The SA 1000 is particularly well constructed, with the mains transformer, all the front panel controls, the rear panel sockets and the printed circuit boards enclosed with sheet metal panals to minimize external interference. The four power transistors are mounted on a large common heat sink, vertically mounted between the perforated sheet-metal bottom panel and the expanded mesh grille in the timber top cover. This arrangement restricts the location of other equipment above the amplifier, as the grille in the top panel must always be clear to allow free air circulation. The amplifier was supplied with an operating-instructions manual and a comprehensive wiring diagram. The wiring diagram included individual circuit board layouts, as well as a large wiring schematic. From our past experience with Pioneer equipment we expected to find more information on the electronic circuitry and performance curves than are provided in this handbook. However, this data is supplied on a separate three-page sales leaflet, which gives a complete set of tone and filter response curves and good descriptive information on the main parts of the circuitry.







MEASURED PERFORMANCE

The measured performance of the SA 1000 was very good and equalled, or bettered, the manufacturer's specifications.

The harmonic distortion was less than 0.25% at all level settings. This is a realistic distortion level resulting in negligible increase in distortion from programme source or speakers. All the other parameters were correctly related to the overall performance of the amplifier and were more than adequate for true high fidelity amplification.

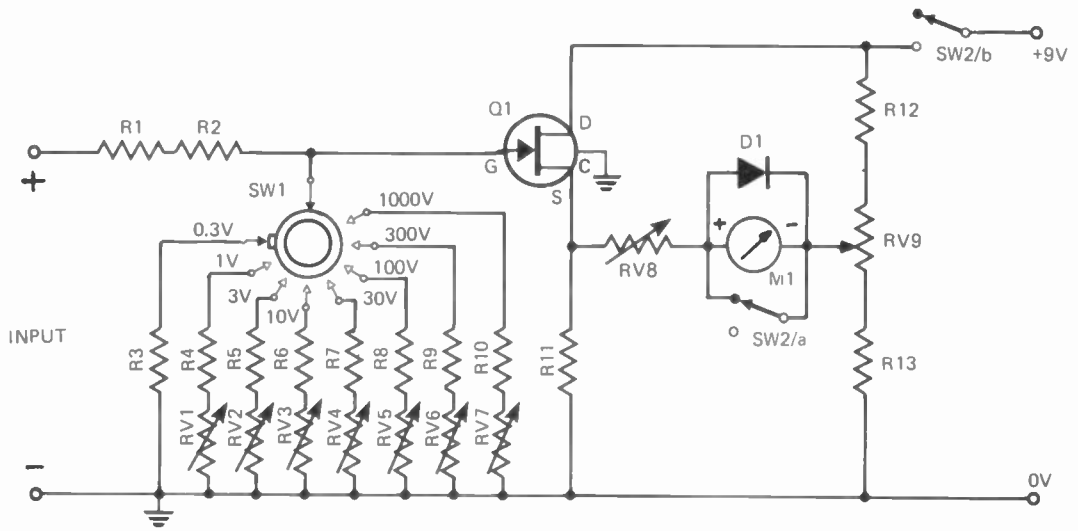
The subjective assessment of amplifiers is rather difficult because basically either they work or they don't. If they don't, then the measured performance will clearly show where the faults are.

Possibly more to the point is the assessment of the ergonomic design of the front panel controls. In this respect the Pioneer SA 1000 is good, with the controls most often used being placed across the top, and the secondary controls being placed along the bottom. A good example is the location of the two most used controls:– the combination power on and speaker select switch, and the source select switches which are located one at each end of the front panel.

The Pioneer SA 1000 is undoubtedly the most versatile amplifier ever produced by the Pioneer Electronic Corporation. It should satisfy the most fastidious purist in terms of switching facilities and performance and, at a price of $430.00, is very good value for money. ●

FET DC VOLTMETER

ETI PROJECT 110



This cheap and easily constructed dc voltmeter has 10 Megohm input resistance.

Fig. 1. Circuit of complete instrument.

PARTS LIST – ETI 110

R1, R2	–	5 Meg 5% ½W
R3	–	18M
R4	–	2.2M
R5	–	560k
R6	–	180k
R7	–	56k
R8	–	18k
R9	–	5.6k
R10	–	1.8k
R11	–	4.7k
R12	–	680 ohm
R13	–	120 ohm
RV1	–	470k trim pot
RV2	–	220k "
RV3	–	47k "
RV4	–	22k "
RV5	–	4.7k "
RV6	–	2.2k "
RV7	–	470 ohm "
RV8	–	4.7 ohm "
RV9	–	250 ohm ww pot
Q1	–	BFW 61 BFW 10, BFW 11
D1	–	OA91
SW1	–	Single pole eight position rotary switch
SW2	–	DPDT Toggle Switch
M1	–	50 uA meter 0-10 and 0-3.16 scales.

For accurate voltage measurements in high impedance circuits it is essential that the measuring instrument has an input resistance that is very much higher than the circuit being measured. If the meter drains current away from the point being .measured then an inaccurate reading will be obtained.

The valve voltmeter (VTVM), with its inherently high input resistance has for many years been used for such measurements.

But until the advent of the field effect transistor (FET), solid state technology was not commonly used in these instruments, for the bi-polar transistor has the disadvantage of having an inherently low input impedance.

The field effect transistor, on the other hand, has a *high* input impedance and because of this, forms an excellent basis for a high input resistance voltmeter.

Here then are constructional details of a simple yet accurate FET dc voltmeter having an input resistance greater than 10 megohms on all ranges.

The attainable accuracy is very much determined by the quality of the 50 uA meter (M1). We have not specified any particular make or type, for this will be determined by the accuracy required. Generally however the meter chosen should be at least four inches in diameter and should have a guaranteed 1% to 2% accuracy at full scale deflection.

Three types of FET may be used in this circuit – BFW10, BFW11, and BFW61. Of these the BFW61 is the cheapest and this is the one that we have used in this project.

High stability resistors must be used throughout. These should be of 5% tolerance (or better). Metal film resistors – such as those produced by IRH or Philips are ideal. Corning Electrosils are also an excellent choice.

CONSTRUCTION

The physical design of the instrument is determined primarily by the size and shape of the 50 uA meter. Within reason the larger this is the better.

A good quality switch must be used for SW1 - preferably of ceramic construction. A single-pole twelve-way switch was used in the prototype (four of the available positions were not used for switching).

The electronic components may be located on tag strips or on matrix

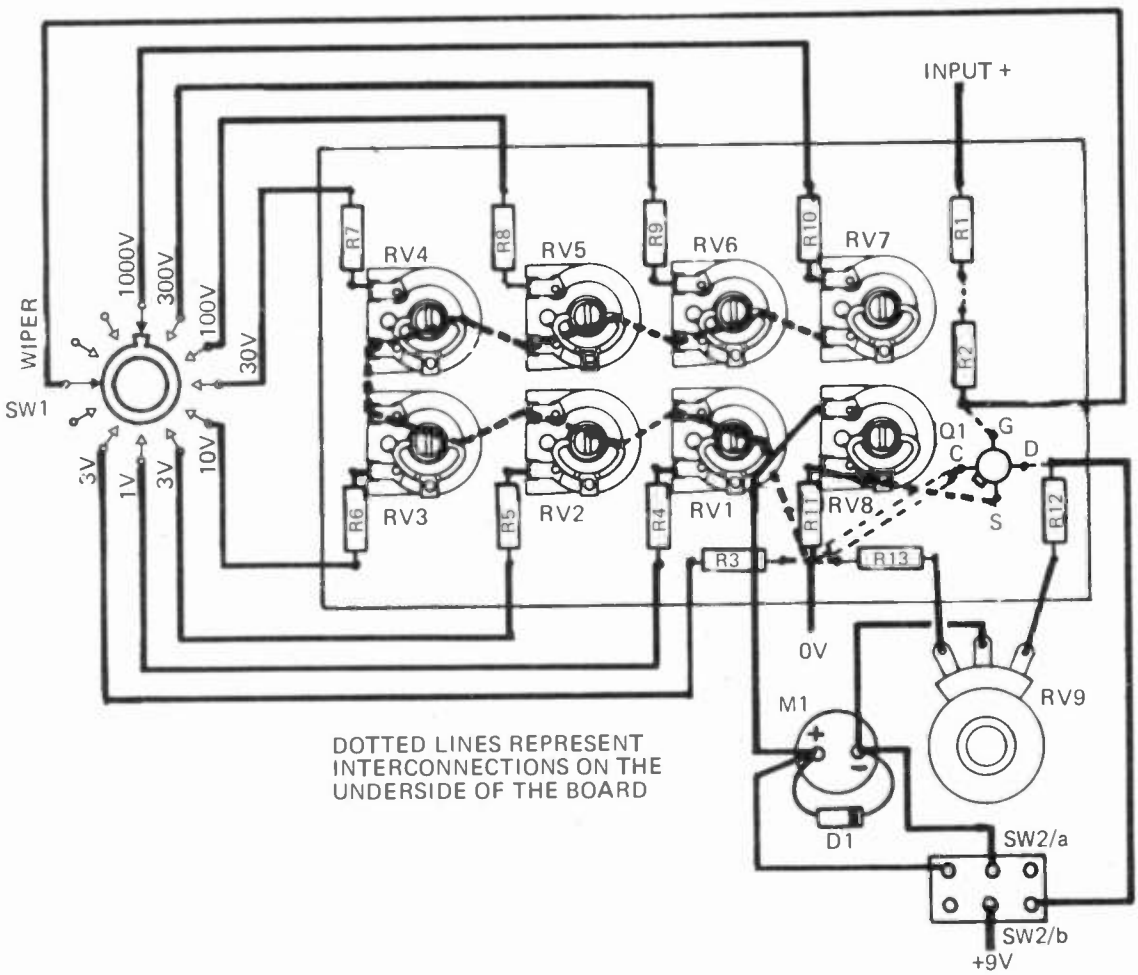


Fig. 2. Interconnections – layout shown here is suited to matrix board construction.

HOW IT WORKS

An eight position switch selects the desired input voltage range. The voltage to be measured is then divided by input resistors R1 and R2 and the resistors selected by the setting of SW1. The division ratio is such that approximately 200mV is applied to the gate of the FET with 100% input.

The naturally high input resistance of the FET together with negative feedback from R11 ensures that, even on the lowest range, there is never less than 18 Megohms in parallel with the lower end of the input voltage divider. This will have a negligible effect on meter accuracy.

Another advantage of using negative feedback is that this limits the working range of the FET thus ensuring good linearity.

All voltage ranges – except the .3V range – have a preset potentiometer for initial calibration. Once set these will not require subsequent adjustment unless a voltage divider resistor or the FET is replaced.

Potentiometer RV8 establishes full scale deflection on the 0-3V range. It is also used to correct for any spread in the transfer conductance (gain) of the FET.

The 250 ohm wire wound potentiometer RV9 is mounted on the front panel of the instrument and is used as a 'zero adjustment'. In effect it cancels out the voltage appearing at the source terminal or the FET when there is zero voltage at the input.

FET DC VOLTMETER

board. A matrix board layout is shown in Fig. 2.

As FET's are a bit touchy about input voltage it is wise to keep their terminal leads shorted together by a thin strand of wire whilst soldering them into the circuit.

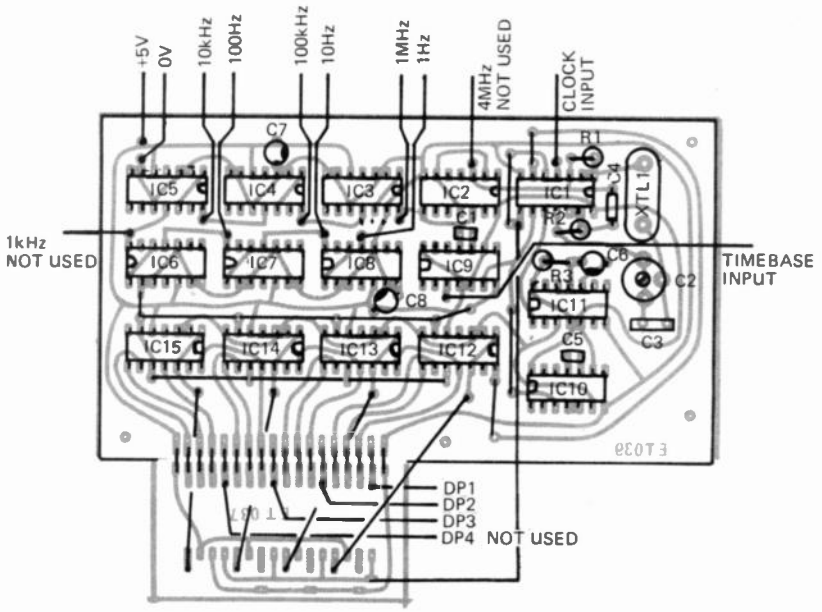
The battery 'on/off' switch should be double-pole double throw. When it is in the 'off' position the second set of switch contacts place a short circuit across the meter movement thus protecting it against mechanical damage whilst the instrument is not in use.

This switch together with range switch SW1 and 'zero-adjust' potentiometer RV9 must be mounted on the front panel of the instrument case.

CALIBRATION

1. Connect the meter to a nine volt battery. Make sure that the polarity is correct. Switch the instrument to 'on'.
2. Switch SW1 to the .3V range. Short circuit the input terminals and adjust the 'zero-set' potentiometer (RV9) for zero meter deflection. Then remove the short circuit.
3. Apply an accurately known 300mV to the meter input terminals and adjust RV8 to obtain full scale deflection on the meter.
4. Repeat steps 2 and 3 until the meter reads correctly both at zero and full scale deflection. Once this has been achieved do not readjust RV8. during any subsequent operation.
5. Switch the meter to the 1V range, apply an accurately known 1V and adjust RV1 to obtain full scale deflection.
6. Now switch to the other ranges in turn and, in a similar fashion to operation 5, apply the appropriate input voltage and adjust the appropriate potentiometers for each range (RV2, RV3, RV4, RV5, RV6, and RV7) to obtain full scale deflection on each range. This completes calibration. ●

ERRATUM



DIGITAL FREQUENCY COUNTER ETI 109.

We regret that due to a printing error the numbering of the integrated circuits on the main logic board shown last month was incorrect. The correct layout is shown below.

The parts list should also be renumbered as follows

IC 19 – uA7805

IC 20 – IC23 HP5082-7302

In Fig. 4 the rear wafer switch wiper contact should go to OV.

(all constructor's who have purchased LED displays for this project from Hewlett Packard have already been advised of these changes).

HEADLIGHT REMINDER

This electronic 'reminder' safeguards against flat batteries.

A car's headlights cost approximately one cent an hour whilst in use. Until you forget to turn them off.

Then you are up for recharging the battery, tow starting, apologizing to the managing director who has just flown 5,500 miles to discuss your future with the company, placating uptight parents whose daughter you returned just after they realized it was now daylight, or whatever combination of circumstances are least favourable to your immediate situation.

To avoid such predicaments is relatively simple and a number of circuits have been published that provide an audible warning if the ignition is switched off whilst the headlights or sidelights are still burning.

These circuits are simple and effective but invariably fail to cater for those occassions when one requires lights to be on whilst the ignition is switched off.

(Continued on page 72)

HOW IT WORKS

Normally capacitor C1 is discharged via R1 and the closed switch contacts of an accessory wired via the ignition switch. If the ignition is now switched off, C1 will charge rapidly via R2 thus producing a negative going pulse at the base of transistor Q1.

If the vehicle's headlights (or side and tail lights) were switched on at this time, this pulse will turn on Q1, and close RLA.

The relay contacts RLA(1) and RLA(2) now close and contacts RLA(1) connect the base of Q1 to ground via R2 and R3 thus causing the relay to 'latch on'.

If either front door of the vehicle is opened with the relay in the latched condition an earth will be extended to the audible alarm device via the now closed contacts of RLA(2) and the closed door light switch.

The audible warning will cease immediately the door is reclosed. Q1 will of course be cut off and the relay reset when the lights are turned off (thus removing the positive voltage from the emitter of Q1).

If at any time it is required to disable the alarm circuit all that is necessary is – having first switched off the ignition – to switch the lights off and then on again. The circuit will revert to the status quo next time the ignition is switched on.

PARTS LIST

PARTS LIST – ETI-307

R1	–	3.3k 5% ½W
R2	–	330 ohms 5% 1W
R3	–	3.3k 5% ½W
D1	–	EM401 – 1N 4005
D2	–	" "
D3	–	" "
Q1	–	BC178
C1	–	25 uf 25V electrolytic cap.
RL1	–	miniature relay type VP2 185-280 ohm coil two change-over contacts.
12V	–	alarm, Sonalert, bell, etc. tagstrip etc.

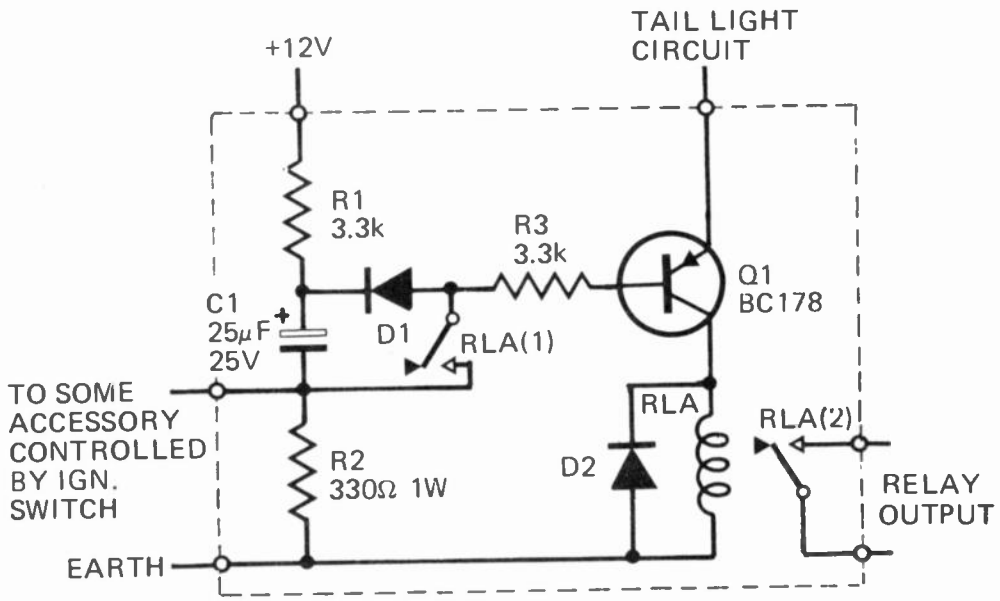


Fig. 1. The basic circuit.

ETI PROJECT 307

HEADLIGHT REMINDER

Here then is a slightly more complex circuit that provides a 'headlight on – ignition-off' warning as the driver opens a door to leave the vehicle. The alarm ceases as soon as the driver closes the door.

The basic circuit is shown in Fig.1. The components may readily be mounted on matrix board or tag strips, and wired as shown in Fig.2.

As shown in Fig.1, the circuit is suitable for vehicles with a negative earth electrical system. To convert the circuit for use with positive earth vehicles replace the BC 178 by a BC108 (the connections are the same) and reverse the diodes and the 25 uF capacitor.

Figure 3 shows how the basic circuit is wired into the car's electrical system. The alarm unit may be a Sonalert, a buzzer, bell or even a flashing light. The existing door-operated interior light is used to extend an earth to the relay thus obviating the necessity to install any additional switches.

The lead marked 'tail light circuit' should be connected to the live side of the tail light wiring. (If a headlight only warning is required, this lead should be connected to the live side of one of the headlights). Further leads connect the unit to earth, the 12V vehicle supply and to the live side of any accessory that is wired through the ignition switch. ●

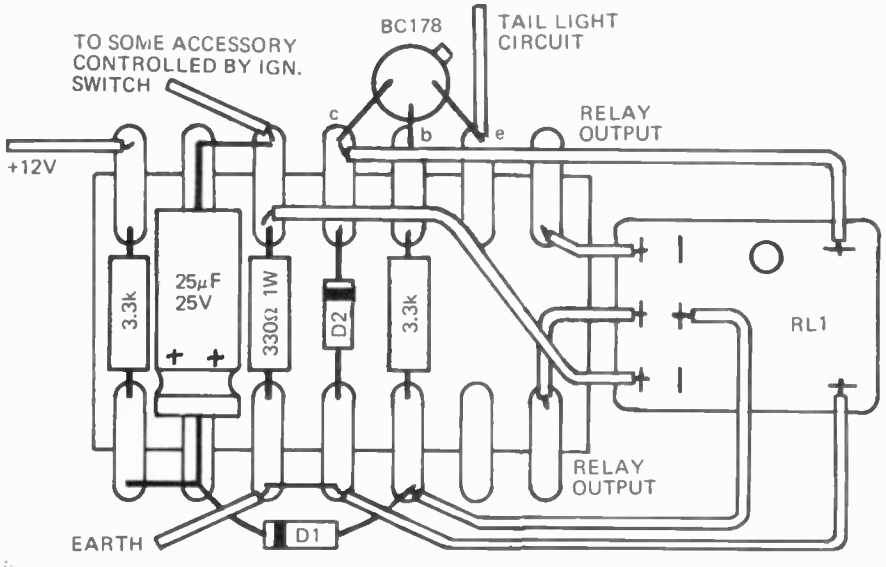


Fig. 2.

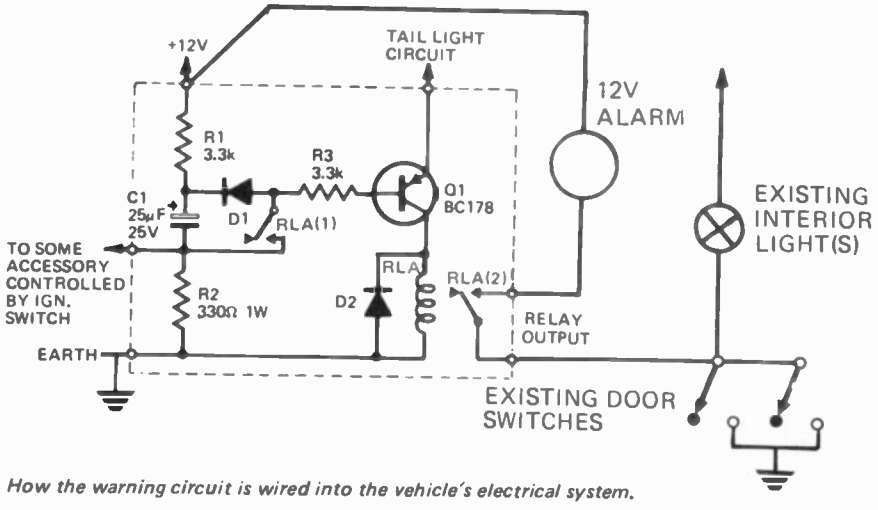


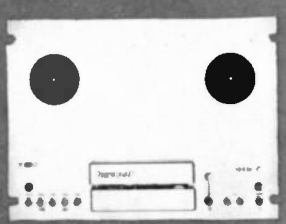
Fig. 3. How the warning circuit is wired into the vehicle's electrical system.

BRENELL *famous recording equipment...from* PLESSEY

Brenell ST400 stereo recorder

Brenell Mark 6 stereo recorder

Brenell Type 19 tape deck



Brenell tape link amplifier

The range of famous Brenell high fidelity magnetic tape recorders, decks and amplifiers for hi-fi enthusiasts and professional users is available in Australia through Plessey.

Brenell ST 400 four-track, three speed stereo recorder. A fully transistorised unit with power amplifiers and inbuilt speakers offering exceptional quality in terms of recording and playback characteristics. 6 watts RMS per channel output, 40 Hz to 14 kHz ± 2 dB frequency response, 56 dB signal to noise ratio, less than 0.08% wow and flutter, bass and treble controls effective both during recording and playback. Also ST 200 two-track stereo version.

Brenell Mk 6 hi-fi stereo recorder. Unquestionably one of the world's most versatile tape recorders for semi-professional users, it is available for two-track or four-track stereo or as a complete monaural unit including inbuilt speakers. Fully transistorised, three motors, three heads, four tape speeds, full mixing and A/B comparison facilities. 15 watts RMS per channel output, 40 Hz to 22 kHz ± 3 dB frequency response at 15 ips, wow and flutter less than 0.05%, signal to noise ratio 56 dB unweighted.

Separate tape decks and amplifiers. For specialists wanting to build up their own systems, Brenell offers high quality tape decks and amplifiers as separate components. The Mk 6 deck is for hi-fi systems, the professional, solenoid-operated Type 19 deck handling up to 10½" reels is designed for industrial and scientific use. Transistorised hi-fi tape link amplifiers for stereo or mono operation are also available.

brenell

PLESSEY Electronics

For further information, contact:
Plessey Electronics Pty Limited Recording Equipment
91 Murphy Street Richmond Victoria 3121
Telephone 42 0431 Telex 30383
NSW Faraday.Park Meadowbank 2114 Telephone 80 0111

Distributors: Qld: L. E. Boughen and Co 30 Grimes St Auchenflower 4066. SA: Roger Electronics PO Box 3 Bodbury North 5092.
WA: Athol M Hill and Co 1000 Hayes St Perth 6000. Tas: United Electronics 23A Frederick St Launceston 7250

AV51

NEW TECHNOLOGY

THE Seventh International Aerospace Instrumentation Symposium and Exhibition was held at Cranfield Institute of Technology (CIT) in England recently. Sponsored jointly by CIT, the Royal Aeronautical Society, the Instrument Society of America and the Institute of Measurement and Control, the biennial events provide a forum primarily for discussion of developments in equipment and techniques of airborne measurement.

This year the scope was broadened to include instrumentation devised for specific functional tasks beyond mere basic vehicle behaviour measurement. The response was enthusiastic; over 160 delegates, representing research establishments, universities and the aerospace industry in 10 countries attended and 17 companies were represented in the exhibition.

Twenty-six Papers were submitted, under the broad group headings of instrument systems, earth sciences, data systems, test philosophy and instrumentation training.

Of these papers, four described techniques of outstanding general interest. Space limitations preclude our reproducing these papers in full, however we present here a brief synopsis together with details of where the complete papers may be obtained.

MEASURING AIR TEMPERATURES 10km AWAY!

The disadvantage of present outside air temperature measuring devices, particularly as applied to helicopters, where flight into icing conditions could have serious consequences, are outlined by Mr Sassoon. Conventional outside air temperature transducers read incorrectly if ice-covered; in any case they provide historical information rather than advance warning.

Working on the principle of variation of noise power received by an antenna pointed at an absorbent medium due to variation in temperature, a radiometric device will, he claims, overcome these problems.

Equipment based on this principle and incorporating thermal feedback has been constructed and a limited series of tests performed with it in an Argosy aircraft. Despite problems of interference from aircraft radio transmissions, results are encouraging and it is considered that this form of radiometer could become a practical aircraft instrument when the difficulties of working at such high frequencies have been overcome. The equipment would work in cloud and, ultimately, forward ranges of up to 10km should be possible.

"A 60 GHz Radiometer for Outside Air Temperature" – G. Sassoon, JZK Electronics.

HIGH PERFORMANCE PRESSURE TRANSDUCER

In this paper the author described a low-range pressure transducer employing electrostatic pressure balance, and gave results obtained from an experimental model of range plus or minus 40 N/m². The work stemmed from a belief that no satisfactory instrument existed for low pressure measurement in demanding environments where significant temperature change and vibration occurred. The performance of present transducers employing diaphragms, membranes, bellows or capsules hinged on the stability of such elements, and materials hysteresis and creep could degrade accuracy.

In the method devised, pressure is measured by a sensitive pressure cell employing electrostatic pressure balance consisting of two pressure chambers separated by a lightly tensioned thin conductive membrane. Polarised electrodes, surrounded by guard rings, are positioned at a fixed distance on each side of the membrane and movement of the latter causes a differential capacitance change to be sensed by an alternating-current bridge having transformer ratio arms (Fig. 1).

It was shown that the electrostatic transducer could measure low pressures with such precision that its use as a low pressure standard was feasible. It would be particularly suitable as the heart of a rate-of-climb indicator with a time lag of about 0.1 second and the adoption of such a fast-responding instrument might make certain aircraft maneouvres, such as landing in bad weather, less hazardous. The method also had application to the measurement of

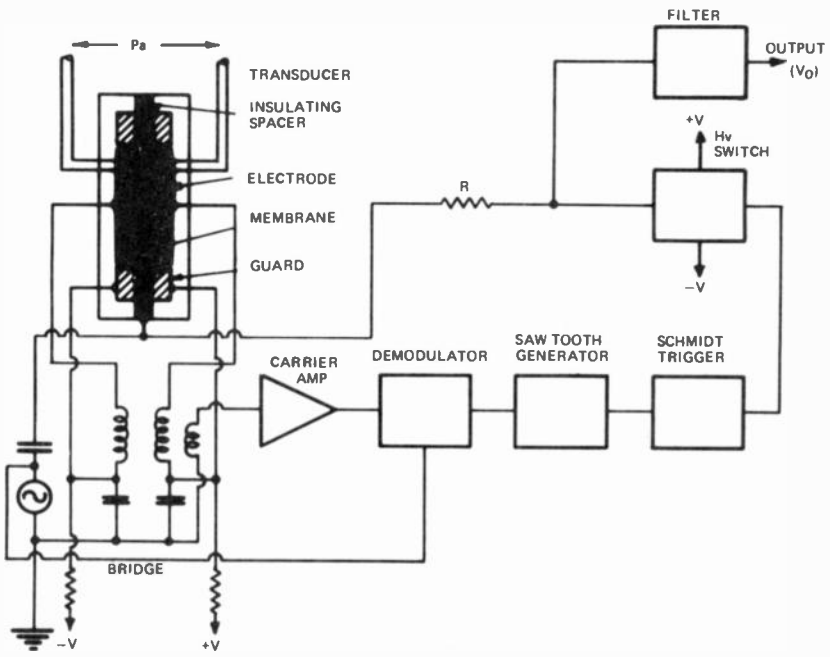


Fig. 1. Electrostatic feedback transducer for measuring very low differential pressures developed by the Royal Aircraft Establishment, Farnborough, England. It has a high order of accuracy and can be used in many areas; an example is a rate-of-climb indicator with a time lag of about 0.1 second.

angular acceleration, where the transducer formed a pressure cell which measured pressure generated within a fluid-filled column.

"An Electrostatic Feedback Transducer for Measuring Very Low Differential Pressures" – W.R. Macdonald, Royal Aircraft Establishment.

***(This paper has already been published as RAE Technical Report TR 71022 and is available from Ministry of Defence (Procurement Executive), Defence Research Information Centre, St Mary Cray, Orpington, Kent BR5 3RE, England.**

MAGNETIC RECORDING HEADS

Dr Lemke's Paper traces recording head developments which, he says have stemmed from demands made by users of instrumentation-class recorders and have always been preceded by recording-tape developments. Tapes have improved in a number of ways, including particle size and dispersion, surface finish, chemical composition and coercivity.

With each improvement, resolution is increased but tape speeds do not reduce, so that heads have to have better resolving power and operate at higher frequencies than before. Figure 2 illustrates the increase in information density achieved by representative recording systems in general use, their specifications and approximate introduction dates, point E representing a system not yet in general use but nevertheless operational.

The two most important mechanical properties of head materials are resistance to slip planing and wear resistance. Head wear is a complex situation dependent on head and tape mechanical and chemical properties and environmental conditions such as humidity. In general the harder the head material the longer the head life; however this situation could be dramatically altered if frictional polymers could be generated on the head surface, thus inhibiting wear.

As for the future, tapes will undoubtedly continue to improve and draw forth new generations of head designs. It is possible to design heads to record tapes of coercivity greater than 1 000 but it is difficult to bulk-degauss such tapes. Surface finish improvements will come from increased track densities. Pitches of 42 tracks/inch (16/cm) are in regular production and batch process heads with hundreds of tracks/inch are under development and will exert great influence on recording methods.

"Recent Advances in Magnetic Recording Heads" – J.U. Lemke, Spin Physics Inc, USA.

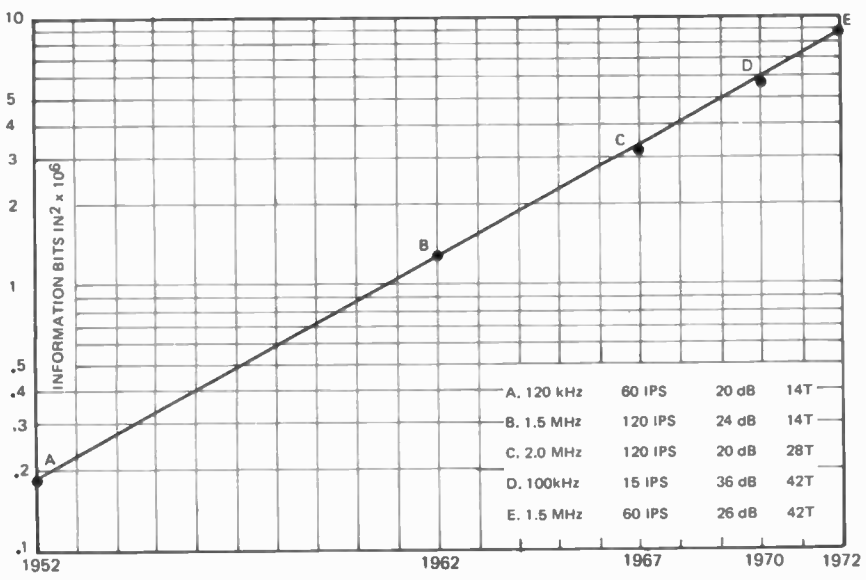


Fig. 2. This graph shows the increase in information density achieved by representative recording systems in general use, their basic specifications and approximate introduction dates; "E" illustrates a system that is operational but not yet in general use.

LASERS FOR DATA RECORDING?

Looking farther into the future, Mr King foresaw that magnetic recording improvements could not continue indefinitely. Increasing demands for extended performance would therefore necessitate a fundamentally different recording method, preferably one with no moving parts, since these tend to cause much unreliability in present recorders.

Two methods showed promise: the magnetic bubble store and the holographic recorder. The magnetic bubble technique has the potential capacity to store 10^8 bits in an 80mm

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All listed prices are in Australian dollars, International Postal Money Orders (please send PO receipt with order for immediate shipment). Banque Chasiers check (preferably in US funds) and rated company cheques (with foreign exchange stamp approval affixed) will be accepted. Oue to recent Australian government restrictions we are not able to clear personal checks . . . All goods are new unused surplus and are fully guaranteed. Orders will be shipped within two workdays of receipt of same. All customs forms will be attached. Minimum order amount is $5.00, do not add postage — we pay postage. Surface mail for orders under $10.00 and Air Mail for orders over this amount.

DATA SHEETS ARE PROVIDED FOR EACH ITEM PURCHASED

DIGITAL INTEGRATED CIRCUITS (dual in line package)

Signetic	TTL (5 volt operation)	
8440	Dual 2/2 and or invert gate	$0.40
8455	Dual 4 input buffer	0.40
8480	Quad 2 input NAND gate	0.40
8H16	Dual 4 input NAND (high speed)	0.40
8H70	Triple 3 input NAND (HS)	0.40
8H80	Quad 2 input NAND (HS)	0.40
8H90	Hex inverter (HS)	0.40
8H21	Dual JK flip flop (HS 60MC)	1.25
8290	Decade counter (HS 60 MC)	3.50
8292	Decade counter (low power)	1.40
8251	BCD to decimal decoder	1.75
7480	Gated full adder	0.80
7413	Dual 4 input NAND Schmidt triggers	1.75
74181	Arithmetic logic unit	5.00
8260	Arithmetic logic unit	3.50
8261	Fast carry for above	1.40

Send for free brochure listing hundreds of bargains.

Signetic DTL (5 volt operation) dual in line

SP629	Flip flop	$0.40
SP659	Dual 4 input buffer	0.35
SP670	Triple 3 input NAND gate	0.35
SP680	Quad 2 input NAND gate	0.35
SP690	Hex inverter	0.35

Signetic "Utilogic"

This family of logic offers medium speed combined with a greater noise margin than is available from either DTL or TTL logic. Power requirements are the same as TTL/DTL (single 5 volt supply).

"Utilogic" dual in line package

LU300	Dual 3 input expander	$0.35
LU301	Quad 2 input diode expander	0.35
LU305	6 input NAND	0.35
LU306	Dual 3 input NAND	0.35
LU314	7 input NOR	0.35
LU317	Dual 4 input expandable NOR	0.35
LU333	Dual 3 input expandable OR	0.35
LU334	Dual 4 input expandable NAND	0.35
LU356	Dual 4 input expandable driver	0.35
LU370	Triple 3 input NOR	0.35
LU377	Triple 3 input NAND	0.35
LU387	Quad 2 input NAND	0.35

LINEAR INTEGRATED CIRCUITS

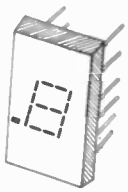
Fairchild and Signetic devices (no choice). Some of this line is not marked but it is fully tested and sold on a money-back guarantee. State first choice on package (TO-5, 8-pin dual in line, or 14-pin DIP—we will **not ship flat packs).**

NE526	High speed comparator	$1.00
NE565	Phase lock loop	4.25
NE566	Function generator	4.25
NE567	Tone decoder	4.25
709	Popular operational amplifier	0.40
5558	Dual 741 op amp (compensated)	1.25
747	Dual 741 op amp	1.10

LED DISPLAY

The MAN1 is a seven segment diffused planar GaAsP light emitting diode array. It is mounted on a dual in line 14-pin substrate and then encapsulated in clear epoxy for protection. It is capable of displaying all digits and nine distinct letters.

FEATURES:



- High brightness, typically 350ft.-L @ 20ma.
- Single plane, wide angle viewing, 150°.
- Unobstructed emitting surface.
- Standard 14-pin dual in line package.
- Long operating life, solid state.
- Operates with IC voltage requirements.

ONLY $4.25

"UTILOGIC" SPECIAL

Ten (10) pieces of LU321 dual JK flip flops and four pages of application information describing ripple counters (3 to 10) and divide by 12 up/down binary and decade counters, shift registers and self-correcting ring counters.

Complete package only $4.00

LINEAR SPECIAL

Ten (10) 741 fully compensated operational amplifiers with data sheet and two (2) pages of application notes covering the basic circuits for op-amps.

EACH $0.65 PACKAGE $6.00

Please specify first and second choice of: TO-5, 8-pin MINI DIP, 14-pin DIP.

LM309K—5 volt regulator

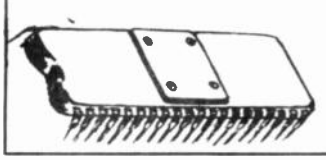
This TO-3 device is a complete regulator on a chip. The 309 is virtually blowout proof, it is designed to shut itself off with overload of current drain or over temperature operation. Input voltage (DC) can range from 10 to 30 volts and the output will be five volts (tolerance is worst case TTL requirement) at current of up to one ampere.

EACH $2.50
FIVE for $10.00

LSI—CALCULATOR ON A CHIP

This 40 pin DIP device contains a complete 12 (twelve) digit calculator, Add, Subtract, Multiply, and Divide. Outputs are multiplexed 7 segment MOS levels. Input is BCD MOS levels. External clock is required. Complete data is provided with chip (includes schematic for a complete calculator).

Complete with data, $14.95



Data only $1.00

COUNTER DISPLAY KIT—CD-2

This kit provides a highly sophisticated display section module for clocks, counter or other numerical display needs.

The RCA DR-2010 Numitron display tube supplied with this kit is an incandescent seven segment display tube. The .6" high number can be read at a distance of thirty feet. RCA specs. provide a minimum life for this tube of 100,000 hours (about 11 years of normal use).

A 7490 decade counter IC is used to give typical count rates of up to thirty MHz. A 7475 is used to store the BCD information during the counting period to ensure a non-blinking display. Stored BCD data from the 7475 is decoded using a 7447 seven segment decoder driver. The 7447 accomplishes blanking of leading edge zeroes, and has a lamp test input which causes all seven segments of the display tube to light.

Kit includes a two sided (with plated through holes) fibreglass printed circuit board, three IC's, DR-2010 (with decimal point) display tube, and enough Molex socket pins for the IC's.

Circuit board is .8" wide and 4¼" long. A single 5 volt power source powers both the IC's and the display tube.

CD-2 kit complete only $10.95
Assembled and tested .. $13.00

Board only $2.50

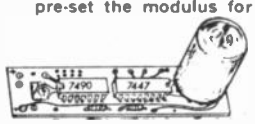
RCA DR2010 Numitron digital display tube. This incandescent five volt seven segment device provides a .6" high numeral which can be seen at a distance of 30 feet. The tube has a standard nine pin base (solderable) and a left-hand decimal point. Each $5.00

SPECIAL 5 for $20

UNIVERSAL COUNTER DISPLAY KIT CD-3

This kit is similar to the CD-2 except for the following:

a. Does not include the 7475 quad latch storage feature.
b. Board is the same width but is 1" shorter.
c. Five additional passive components are provided, which permit the user to program the count to any number from two to ten. Two kits may be interconnected to count to any number 2-99, three kits 2-999, etc.
d. Complete instructions are provided to pre-set the modulus for your application.



CD-3 board only $2.25
IC's 7490, 7447 2.75
RCA DR2010 tube 5.00

Complete kit includes all of the above plus 5 programming parts, instructions and Molex pins for IC's. **Only $9.25**

256 BIT BI-POLAR FIELD PROGRAMMABLE READ ONLY MEMORY

This Signetic No. 8223 IC operates at 5 volts and contains 32 x 8 bit wide ROM which can be field programmed.

Each $10.00

We can provide these devices programmed to your specifications @ $5.00 for the first one and $2.00 each additional one. Please allow one week for programmed units.

Babylon Electronics Inc.

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NEW TECHNOLOGY

cube but suitable storage material has yet to be developed. However laser beam storage can provide a gigabit capacity single on-line mass memory, accessible electronically in microseconds without present-day cores, drums, discs and tapes.

The most practical non-mechanical laser beam deflector appears to be the Bragg diffraction cell (Fig. 3). Direct mode recording difficulties may be overcome by first composing data into blocks, or pages, which are then recorded as holographic images (Fig. 4). A bismuth titanite ferroelectric crystal may provide the most suitable recording medium where selective erasure is required; where no erasure is necessary a photographic emulsion will probably give best results. The high angular sensitivity of the laser beam permits three-dimensional storage which, it is estimated, can be as much as 10^{10} bits/mm^3.

The ideal laser light source for airborne holographic recording does not yet exist, but with a precise specification of required characteristics, prospects for its development are good. However it will be some years before the development of all the individual components makes a practicable airborne holographic data recording system feasible.

"New Digital Recording Methods for Flight Data Acquisition" — J.W. King, Royal Aircraft Establishment, England. ●

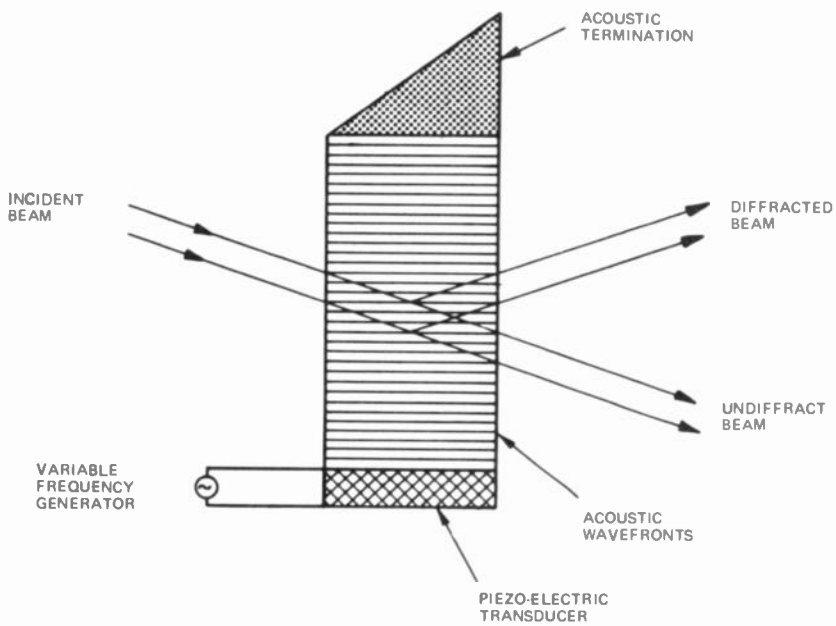

Fig. 3. Acousto-optic light beam deflector — the Bragg diffraction cell. This is said to offer the most practical answer in situations where a laser beam deflector cannot be employed.

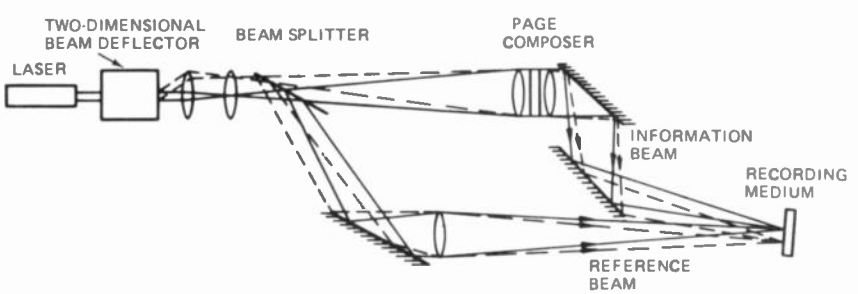

Fig. 4. Direct mode recording difficulties can be overcome by first composing data into blocks and then recording the blocks as holographic images on a set-up such as the one illustrated.

PORTABLE SOUND SYSTEMS

(Continued from page 22)

outstanding sound-reinforcement tool. The wide horizontal front distribution pattern of a column speaker is generally the same as that of any single loudspeaker within the column; the design of the column has virtually no effect on horizontal distribution. It is the length of the column that determines the *vertical angle* of dispersion — the longer the column the smaller the angle.

Microphone shown above has integral 'pop' filter. Proximity effect is minimized as a result of holes in handle above mounting bracket.

Some column speakers use rear ports to produce a bidirectional low-frequency horizontal polar pattern. This design reduces the omnidirectional low-frequency characteristic, which might lead to acoustic feedback, the bidirectional characteristic provides a relatively "dead" area at the sides of the column, with the result that microphones may be placed there with minimal low-frequency-feedback problems.

SPEAKER PLACEMENT

It must be remembered that every room or space is acoustically unique and there are no set rules for speaker placement. However, a number of generalizations may be made which will at least provide a good starting point.

Always consider speaker placement in relation to microphone placement. It is desirable for the loudspeaker and microphone to be in close proximity in order to provide the illusion of source-oriented sound. It is also desirable to keep loudspeaker and microphone separated in order to achieve a high threshold of acoustic feedback. While these two statements are contradictory, a good solution can generally be found. When the column speakers are used on stage, the speakers should be placed at each side of the stage and as far forward as possible. With this setup; the entire stage area will be relatively free from acoustic feedback; also the illusion of sound coming from the centre of the stage will be quite good except for those occupying the first few forward rows of seats.

Generally the stage is higher than the main audience area, therefore placing the speakers on the stage helps to project sound over the heads of the audience. If the stage is low, or a dance floor is directly in front of the stage, it may be necessary to raise the speakers by placing them on platforms or solid boxes.

Keeping in mind that the speaker columns have a narrow coverage angle in the vertical plane and a broad coverage angle in the horizontal plane, we can generalize on speaker requirements for various room shapes. A deep, narrow auditorium would generally require only two speakers if the seating is all on one level. If balconies are added to this same room, additional speaker columns would be required to aim sound up into them. A shallow, broad room might require four speakers in order to cover the entire horizontal expanse. Again if balconies are added, four more speakers might be required to expand the vertical coverage. A "theatre-in-the-round" configuration will almost always require the use of at least four columns. More speakers might be required to provide adequate horizontal coverage if the theatre is very deep.

Adequately to cover all phases of speaker placement in all types of rooms would consume a great deal of space and still would not answer all possible criticism and arguments. *Every* room is different from *any* other and thus correct speaker placement will vary from room to room.

Good speaker placement will provide an audience with even distribution of sound intensity, sound which is free from excessive reverberation and echoes, and the illusion of sound emanating from the real source.

Providing good sound reinforcement is an art-science requiring considerable technical knowledge and a good deal of practice to become a master. However, by using the techniques we have discussed, the performer and soundman should be able to improve their performances. Good equipment is necessary, but proper use of the equipment is of greater importance. Using these guidelines as a tool, the performer must experiment with his equipment to find the particular sound he desires. In this respect microphone placement, mixer/amplifier control settings, and speaker placement are like tuning a fine instrument. Of these, the correct placement of speakers is the hardest problem to solve. Only after a great deal of practice will you be able to make good first choices. Let the people in the audience be your judge and listen to their comments. ●

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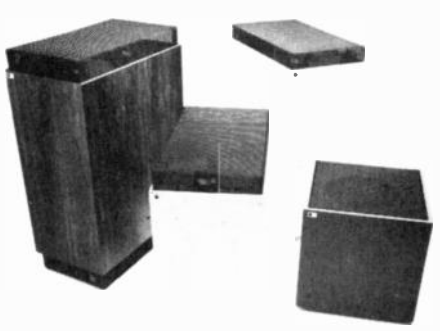

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PART 6

TRANSDUCERS IN MEASUREMENT AND CONTROL

In this, the sixth article in this continuing series, Dr. Sydenham discusses the history and technique of temperature measurement.

PREVIOUSLY we have discussed dimension, which is termed an extensive variable, where two physical lengths (or angles) can be placed together to produce the sum of the two. By contrast there are some physical parameters that cannot be added this way, as addition of equal quantities merely produces the same value. These are known as intensive variables of which temperature is one.

It is now known that heat is a form of energy but it has only been regarded this way since the late 18th century when Benjamin Thompson proposed the energy theory using, as an example, the boring of cannon. Prior to this, a substance known as caloric was thought to permeate all matter: the more caloric present, the hotter the body.

Experimental evidence shows that heat energy is stored as rapid molecular motion. Boyle had suggested this concept in the late 17th century, but it was Joule who finally demonstrated the numerical equivalence of heat energy and mechanical energy in the 1840's.

Temperature is the measure of the degree of hotness or coldness of a substance and a thermometer is a sensitive device used to indicate temperature in a convenient manner. Human senses are very limited when attempting to resolve temperature differences.

When two substances at different temperatures are placed in physical contact, heat flows from the hotter to the colder until thermal equilibrium is reached, that is, they reach the same temperature. This axiomatic law of thermodynamics enables auxiliary devices to be used to sense temperature. In many cases the presence of the thermometer may alter the measurement, so care is needed when using temperature sensors.

SCALES AND UNITS OF TEMPERATURE

As temperature is directly related to molecular kinetic energy, it is theoretically feasible to define temperature in terms of the mass and

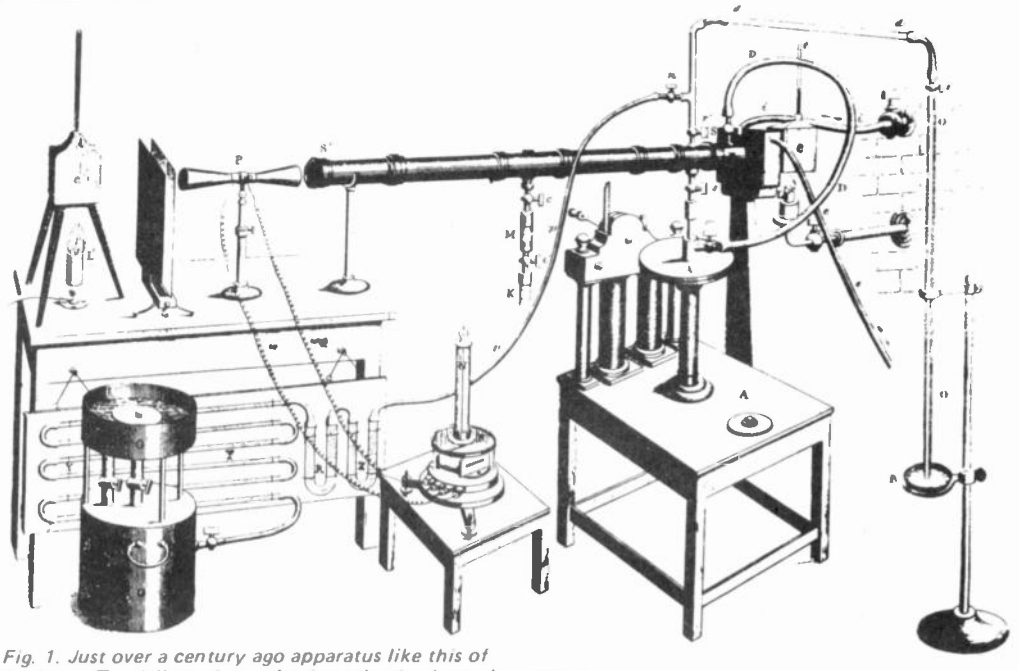


Fig. 1. Just over a century ago apparatus like this of Professor Tyndall was in use for investigating heat phenomena.

velocity of the molecules but this is not possible practically as yet. The high precision of mass, length and time standards (errors less than parts in 10^9 in each case) cannot be realised when measuring masses as small as molecules. Other methods of standardizing temperature have therefore been devised.

Practical thermometers existed well before the energy concept was accepted and ancient references credit Galileo with inventing the first around 1590. These early thermometers used the fluid (liquid or gas) expansion effect and it was not until the 1820's, when the basic laws of electricity were discovered, that electrical methods began to appear for measuring temperature. Figure 1 shows how a laboratory was equipped in 1860 to investigate heat and radiation.

Early thermometers used liquids expanding inside slender glass tubes and had scales which were simply equal length divisions ruled along the tube. It is easy to see that there was not necessarily a relationship to others made elsewhere.

In the late 17th century, it was realised by several people that the transition points where ice melted to water and water boiled to steam could be used as invariant standard points for a temperature scale. Newton is said to have used human armpit temperature as an invariant point on his scale and the familiar, but now deprecated, Fahrenheit unit (devised by Daniel Fahrenheit in 1710) had 100 degrees chosen to range from the coldest laboratory temperature known at the time to body temperature. In 1742 Celsius, of Uppsala, proposed the scale which designated 0 deg. as the icepoint of water and 100 deg. as the boiling point. (The Centigrade scale was independently suggested a year later but is now correctly called only Celsius). The remaining problem was how to accurately subdivide between the two fixed points — there were as many values at the end of the 18th century as there were interpolation thermometers. Liquid-in-glass thermometers are still most useful in everyday measurements, and as sub-standards, for nothing has been devised which is as reliable and inexpensive. For standards use, however, they have been overshadowed by superior methods.

Boyle's law states that the product of the volume and pressure of a given mass of gas is constant at constant temperature. The law holds well for the gases that are hard to liquify such as helium, oxygen and nitrogen. Boyle's contribution led to the Charles-Lussac-Gay law (they each had a hand in its discovery in 1787). This shows that the thermal coefficient of expansion of all gases is the same, provided they are held at constant pressure. This provided a more promising standard thermometer principle, for the actual gas used was of little consequence. Furthermore, the expansion coefficient of gases exceeds that of liquids and solids. In the early 19th century, air-filled thermometers were the accepted standard, as scientists could construct their own and obtain the same results.

In an effort towards further improvement, scientists of the time again turned to thermodynamics and it was Lord Kelvin who realised that Carnot's heat-engine cycle held the key to an absolute thermometric scale. The Carnot cycle is the most perfect thermal cycle that can exist in a heat engine. The Otto cycle is a less perfect one used in some internal-combustion engines and the Stirling cycle is another. Each of these are practical realisations of ways to convert full energy into mechanical energy via a thermal process. In essence, Carnot's theory states that the maximum efficiency of energy conversion occurs when the temperature of the energy input medium (be it steam, petrol combustion, etc.) at each stroke is made to vary from the hottest available at the commencement of the cycle extracting the heat, to the coldest possible, that is, absolute zero. This is logical, for no heat can be transferred from an object at absolute zero, as nothing can be made colder. Absolute temperature can, therefore, be defined theoretically and Kelvin defined his absolute, or thermodynamic, scale with zero at the absolute zero. He also chose the value of 273 degree K (K is the symbol for absolute temperature) for the ice point. The thermodynamic scale is easily related to Celsius values, for only the value 273 has to be added to Celsius values. He chose fixed points along the scale to coincide with various transitions of state. Kelvin's scale is identical with the gas thermometer scale.

In 1927 it was internationally agreed that six reproducible equilibrium

tp — triple point bp — boiling point fp — freezing point	1927 ITS-27 C	1948 ITS-48 C	1948 IPTS-48 C	1968 IPTS-68 C	 K
tp hydrogen				−259.34	13.61
bp hydrogen, 25/76 atm.				−256.108	17.042
bp hydrogen				−252.87	20.28
bp neon				−246.048	27.102
tp oxygen				−218.789	54.361
bp oxygen	−182.97	−182.970	−182.97	−182.962	50.188
fp water	0.000	0			
tp water			+0.01	+0.01	273.16
bp water	100.00	100	100	100	373.15
fp zinc				419.58	692.73
bp sulfur	444.60	444.600	444.6		
fp silver	960.5	960.8	960.8	961.93	1235.08
fp gold	1063	1063.0	1063	1064.43	1337.58
fp tin		231.9	231.91	231.9681	505.1181
fp lead		327.3	327.3	327.502	606.652
fp zinc		419.5	419.505		
bp sulfur				444.674	717.824
fp antimony		630.5	630.5	630.74	903.89
fp aluminium		660.1	660.1	660.37	933.52

Fig. 2. The temperature scale is defined by several fixed points. This summarized table shows the minor changes made as measurement improved.

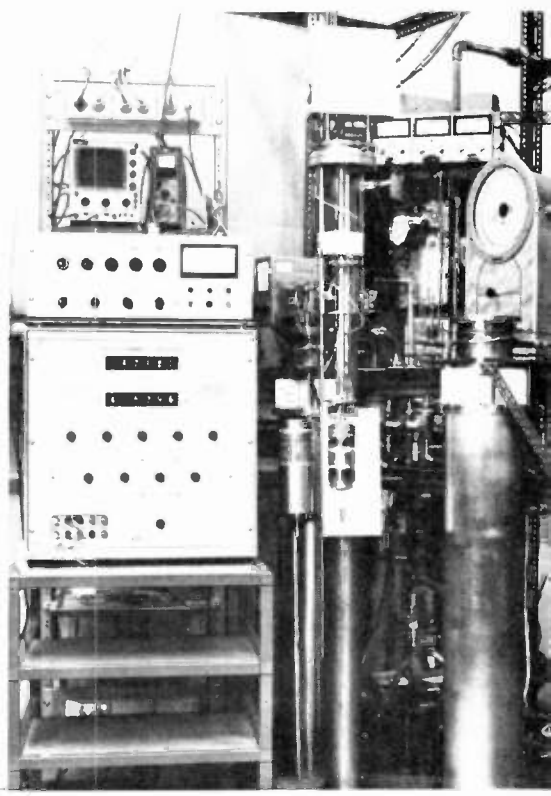


Fig. 3. Establishing the oxygen point (−218°C) on the IPTS-68 scale at the National Standards Laboratory in Sydney.

states be used to define the absolute scale and Celsius values were assigned to each. This is known as the International Practical Temperature Scale, IPTS for short. In 1948, and again in 1968, small changes were made in the values of the definitions as can be seen in the table of Figure 2 where the main features are shown. In general, the normal user of thermometers does not become involved in lengthy standardisations – (one equipment is shown in Figure 3). Instead we have secondary standards (calibrated thermometers of various kinds) that are used only to calibrate everyday instruments. Interpolation between the IPTS fixed points is made with defined electronic thermometers which are able to provide the continuous scale division required. Several methods are used – the resistance thermometer covers the range up to 630 deg.C, thermocouples from there to 1064 deg.C and above that the indirect radiation method of pyrometris takes over.

TRANSFER OF HEAT

A proper understanding of temperature measurements (do not forget measurement must precede control, and control is only as good as sensor accuracy) requires a knowledge of how heat is transferred. This gives clues to obtaining accurate measurements and provides us with principles that can be invoked to transduce temperature. It is by looking at the fundamental principles in new ways and in new combinations as technology changes, that our state of the measurement art is improved.

Heat transfers by conduction, convection or radiation processes. Conduction is explained by the kinetic energy principle, in which adjacent particles impart energy to those having lower energy. The energy exchange process continues until thermal equilibrium is established. The rate at which conduction takes place is decided by the thermal conductivity of the material and this parameter is most important in temperature measurement and control.

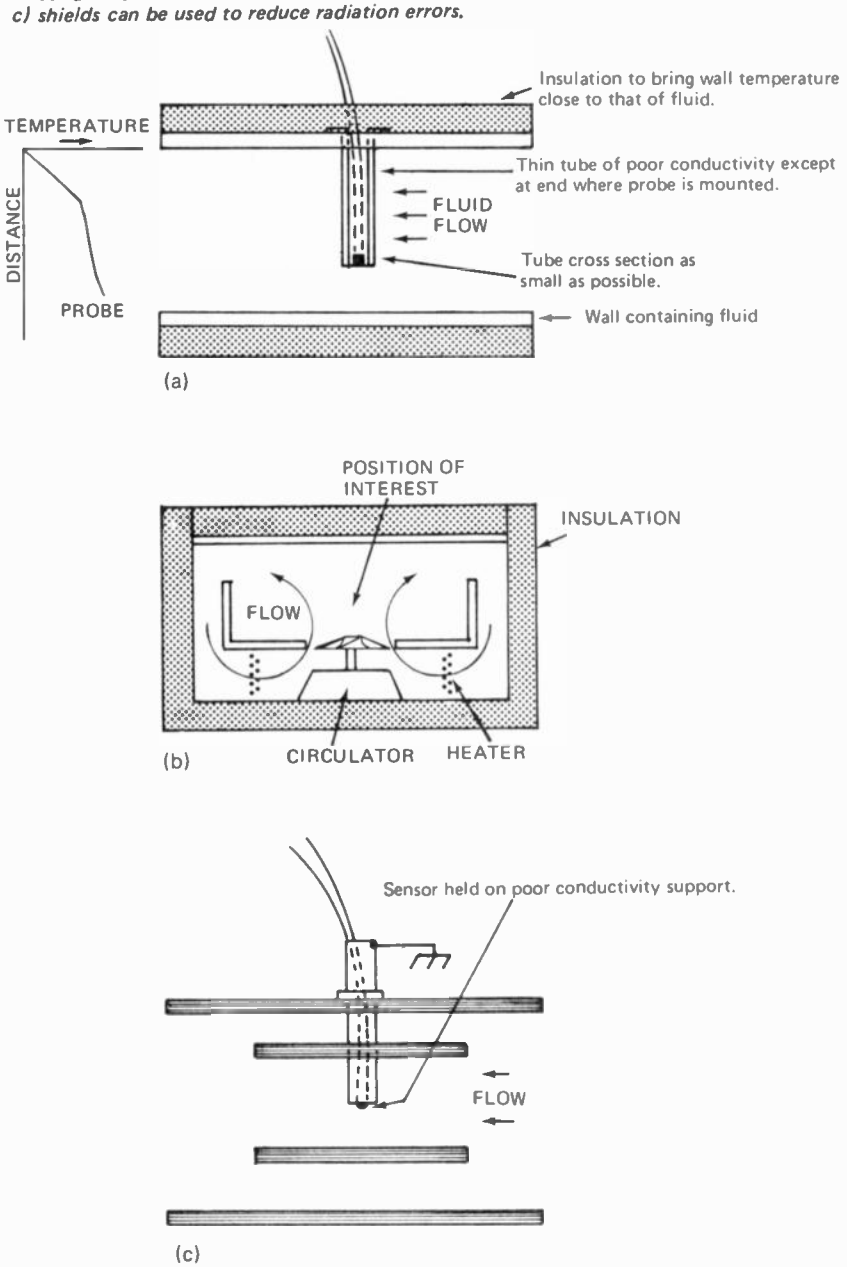
If a slab of material is heated at one end, the rate of heat flow is dictated by its thermal conductivity and the temperature difference between the ends. Thermal conductivity can be regarded as analogous to electrical conductivity, as can heat flow to current, and temperature difference to voltage. Consequently, the solution of thermal conductivity problems can be treated in much the same way as simple series electrical circuits. A fact often overlooked, however, is that the interfaces between layers may have considerably greater thermal resistance than the layers themselves. By way of an example, when air is flowing in a steel pipe at room temperature and atmospheric pressure, the tube has 100 arbitary units of thermal conductivity, the air-steel interface 20 and the air to internal probe 0.02 units. Consequently, when a thermometer is used it must be ensured that the active part of the device is truly at a closc enough temperature to the body or fluid being measured. Silicon grease is a good heat conductor and is used to bed transistors onto heat sinks and thus obtain good thermal contact: a similar practice is recommended when bedding temperature sensors. Sometimes the sensor dissipates heat. In this case the indicated temperature will be high, as the sensor will be at a higher temperature than the body being measured, due to encapsulation conductivity. Another source of error could be that the thermometer mounting is conducting external heat to, or away from, the sensor. Simple basic rules for such cases are shown in Figure 4a.

Convection occurs in substances that can flow: heating reduces density and colder sections of fluid therefore settle displacing the hotter. If there is no

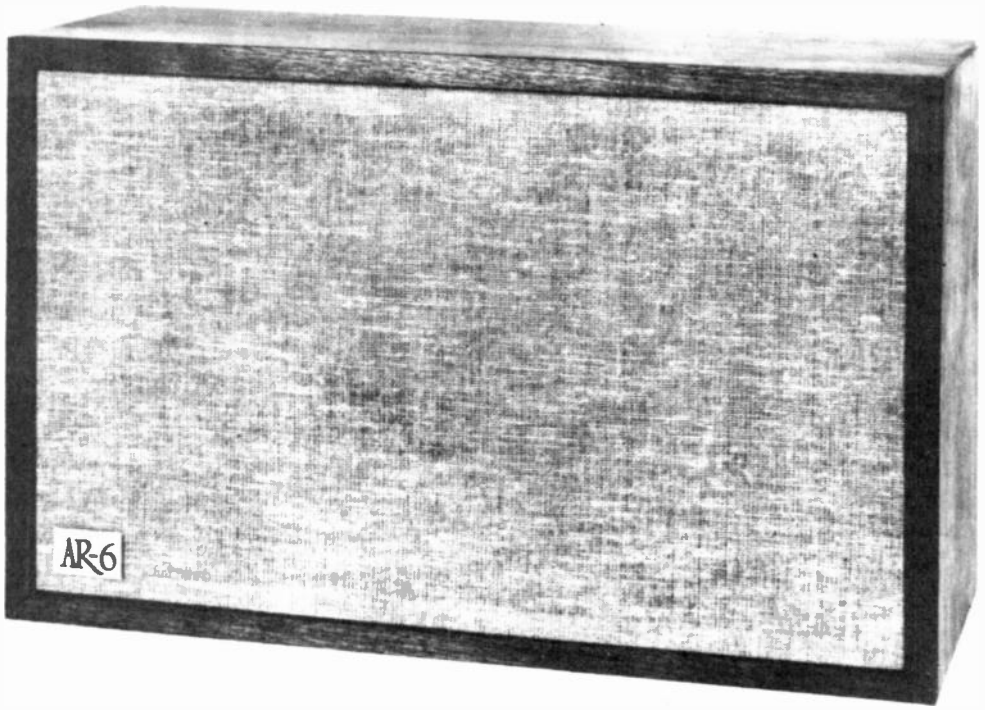
(Continued on page 85)

Fig. 4. Mounts for thermometer sensors need good thermal design to reduce errors due to thermal transfer mechanisms.

a) points to be observed when installing a thermometer well.
b) a good temperature-controlled bath circulates the fluid to reduce convection and conduction errors.
c) shields can be used to reduce radiation errors.



The AR-6 speaker system from Acoustic Research.



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The response curves taken at CBS Labs tell a good part of the story. Note that across the largest portion of the audio spectrum and especially through the midrange the AR-6 responds almost like an amplifier . . .

Directional effects through the treble region, as evidenced by the average of 2dB that separates the three response curves, are actually less pronounced than we've seen in some costlier systems. Tests made of the effect of the tweeter level control show that it can vary the response from completely minus the tweeter to a steady increase in tweeter output of about 2 dB across its range. The design in this particular area is just about perfect . . . Pulse tests indicate virtually no ringing; in fact the AR-6 seems better than average in this regard too.

. . . a pair of AR-6s would be an excellent choice."

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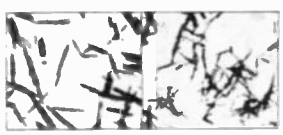

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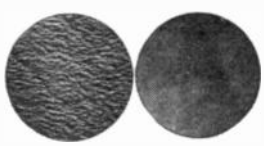

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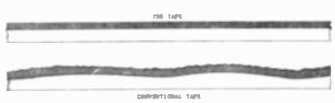

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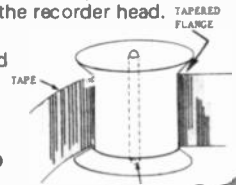

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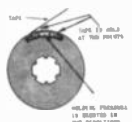

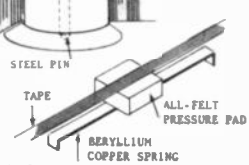

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TRANSDUCERS IN MEASUREMENT AND CONTROL

(Continued from page 82)

physical medium, convection cannot exist. If, however, the temperature gradient in a medium is sufficiently small, convection will cease producing what is called inversion. Again sensor location must be chosen accordingly. In a car engine the temperature gauge sensor is placed high in the block to ensure a conservative reading. Fluids with poor thermal conductivity should be stirred, Figure 4b, to obtain reliable temperature measurements.

The third form of transfer, radiation, transmits heat by virtue of electro-magnetic (EM) radiation. More will be said of this in the following part where non-contacting methods are discussed. Radiation is most effective in vacuum for the EM waves are not attenuated by any interposed medium. The degree of transfer depends much upon the surface characteristics and is greatest when irregularities are of the same size as the radiation wavelengths. Shields are sometimes used around a sensor, as in Figure 4c, to ensure that the thermometer is measuring the medium and is not influenced by external radiation.

The measurement of temperature is as old as dimensional measurements; there are, therefore, many methods in use today. They can be grouped into expansive, direct electrical, radiation and acoustic techniques, in the main, with a large group of miscellany which sometimes provide answers for unusual problems. In this part we will consider expansion and direct electrical methods. For details of practical circuits used in temperature controls, refer to the series on temperature control which commenced in the August issue.

EXPANSIVE DEVICES FOR MEASURING TEMPERATURE

Of the many means by which temperature changes effect physical things, the most obvious is movement due to expansion and contraction. It is, therefore, not so surprising that the earliest thermometers operated on this principle with water, alcohol and, later, mercury in glass tubes.

In expansion thermometers, operation depends on the relative coefficients of two materials, which may be solids, liquids or gases in various combinations. The indicated temperature is not absolute, so standardisation is needed. We shall see that some methods -*are* absolute producing an output that is directly related to temperature.

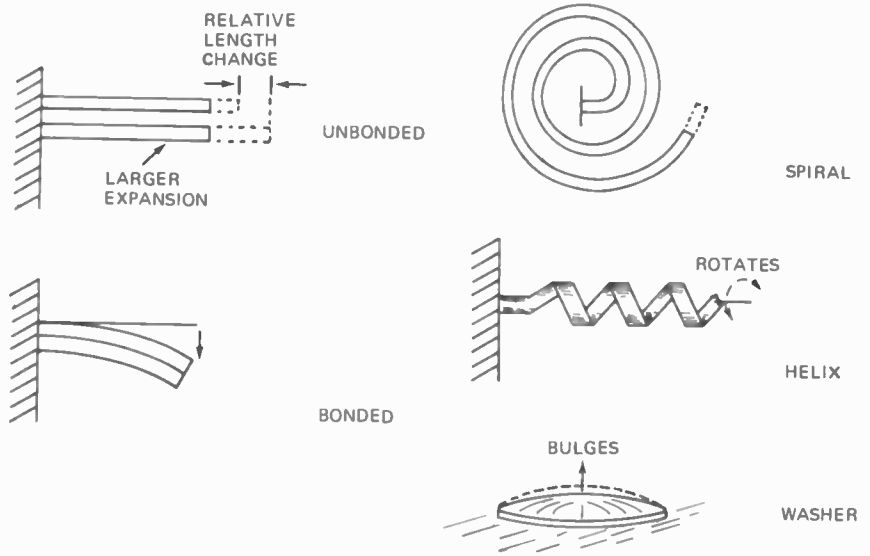

Fig. 5. Two metals having different expansion coefficients are often used to provide a dimensional movement from a temperature change.

BIMETALLIC SENSORS

If an attempt is made to measure the change in length of a rod due to temperature effects, it will be found that the standard which is used for comparison may be altering in length also. Ideally, the standard should be made of a zero thermal coefficient material or be temperature controlled during the measurement. To avoid these requirements, the relative length change between two bars of different coefficient material is monitored rather than the complete length of each. In the bonded bimetallic thermostat, two strips of different metals are bonded together. If each has a different thermal coefficient, the strip must bend as the temperature changes. Ideally, the two should have the greatest possible difference in expansion rate, implying the use of the largest positive and the largest negative coefficient materials. Few satisfactory negative materials exist, so conventional designs use a combination of the smallest and largest positive materials – invar and steel or brass alloys usually. A variety of shapes are used as illustrated in Figure 5 – flat-strips, coiled helixes, disk washers and flat spirals. In each case temperature change produces a linear or rotary movement which is used to actuate contacts or drive a microdisplacement transducer (if a continuous output signal is needed). Although these methods are generally regarded as useful to a precision of only 0.1 deg.C (due to marketed versions being made to perform only to such limits), they are capable of extreme sensitivity if coupled to secondary transducers. Their simplicity, low cost and range capability, from –50 to 500 deg.C, makes them an obvious first choice for temperature control. The same principle is often used to produce a mechanical movement to compensate for temperature errors in an instrument.

LIQUID-IN-GLASS THERMOMETERS

Early thermometers used water in a fine glass tube that was open at the end. It was soon realised that the varying air pressure seriously influenced readings and now the top space is filled with an inert gas at sufficient pressure to keep the liquid thread continuous. It is the relative volume change between the glass (steel sometimes) container and the liquid that causes the liquid to move in the graduated tube. Thermometers must, therefore, be used in the same conditions of immersion (bulb only, thread and bulb or complete unit) in which they were standardized.

Mercury is not the most sensitive liquid, toluene expands in volume at a rate five times that of mercury, and methyl alcohol at seven times. It is, however, particularly useful in contact thermometers where the mercury thread completes a circuit with an internal contact and hence, for example, cuts off the heater in a control system – see Electronics Today International, August, 1972 issue. The difficulty with liquid expansion thermometers is that range must be reduced with increasing sensitivity. Special designs are used, such as the Beckmann thermometer, in which the set point can be varied by manipulating the quantity of mercury in the reservoir, placing that unwanted in an upper storage reservoir. These can be read to 0.001 deg.C within a

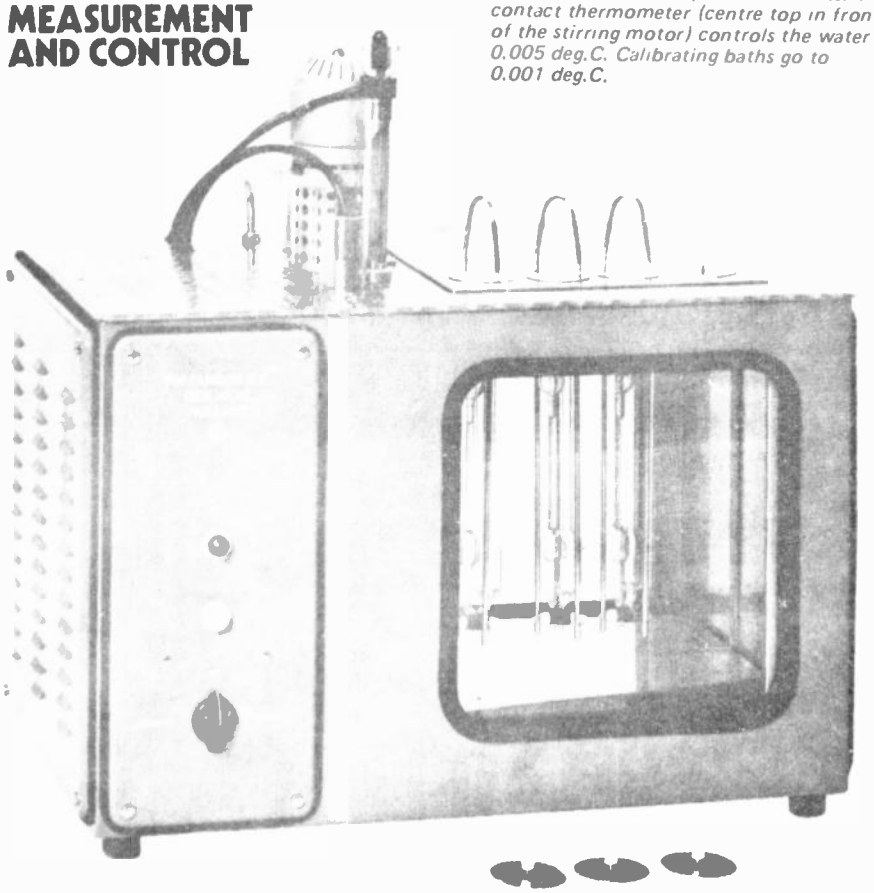

Fig. 6. This precision temperature bath is used to make viscosity measurements. The contact thermometer (centre top in front of the stirring motor) controls the water to 0.005 deg.C. Calibrating baths go to 0.001 deg.C.

range of 5 deg.C and contact thermometers sensing to 1 millideg.C have been used. A precision, controlled temperature bath is shown in Figure 6.

A disadvantage of the liquid-in-glass thermometer is its zero depression characteristic. When subjected to a temperature change, the glass volume changes as does the liquid. The glass, however, takes a finite time to regain its original volume so a movement back toward zero from a higher temperature causes a depression of the zero which can last several hours or even days, depending upon the sensitivity of the thermometer. The effect is not large – modern glasses give rise to 0.01 deg.C error per 100 deg.C change.

Although mercury-filled manometers (devices for measuring pressure by the height of a column of mercury) have been automated to provide a readout of thread position as an electrical signal, it is surprising to find that no commercially available, proportional-output mercury-thermometer is marketed.

Also operating on the expansive principle are pressure thermometers in which mercury or xylene completely fill the system under an initial pressure. Heat at the bulb causes the internal pressure to rise operating a pressure sensitive element such as a bourdon tube or diaphragm which is electrically instrumented. Some car temperature gauges and most radiator thermostat units operate this way, the latter illustrating a neat solution where electronics could not provide as simple an answer.

QUARTZ CRYSTAL THERMOMETERS

The resonant frequency of a quartz crystal depends upon temperature. Temperature changes crystal dimensions and the velocity of acoustic waves within it.

In operation (the Hewlett Packard version is shown in Figure 7) the frequency is measured by a timer counter and displayed directly in degrees by a digital readout. The advantages of the method are its high degree of linearity (±0.05%) (as good as the best platinum resistance thermometer) and resolution. In the short term, it is possible to discern 100μdeg.C changes; over longer periods 0.01 deg.C.

DIRECT ELECTRICAL METHODS

All methods discussed so far make use of heating effects to provide a mechanical displacement, to which a secondary electrical output device could be attached. Several direct, that is, temperature to electrical signal, methods exist. These can be grouped as resistance, thermoelectric, thermistor and semiconductor junction thermometers. Thermistors are a form of resistor but their differences are distinct enough to place them in a category of their own. The first two methods date back to the early 19th century, the others to just a decade or two ago, for they are products of the semiconductor age.

RESISTANCE THERMOMETRY

Although Sir Humphry Davy had realised in 1821 that the resistance of metals generally increased with increasing temperature, it was not until 1871 that this observation was put to use for temperature measurement. At that time Sir William Siemens constructed a special Wheatstone bridge for measuring changes in temperature of the resistance sensing element in his

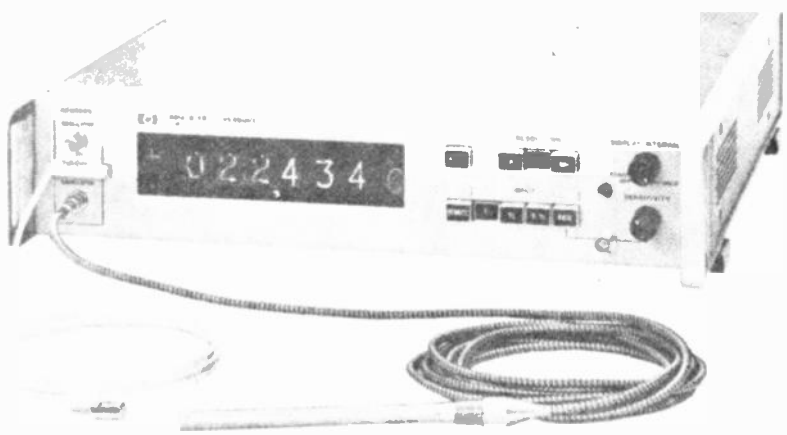

Fig. 7. The Hewlett-Packard quartz crystal thermometer with digital readout can monitor temperature to 100udeg.C.

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radiation detecting instrument. The modern form of resistance thermometer is due to Callendar and Griffiths who published a work in 1887 upon which today's procedures have been largely based. Resistance thermometry is still the most reliable method available, (along with thermocouples) being simple to use, having a good degree of linearity over a wide range and, not the least, assured long-term stability. It is not as sensitive as modern methods however.

In practice, the temperature sensing resistance is placed in the environment to be measured and its value read using a modified Wheatstone bridge. The resistance values are necessarily low (100Ω is typical) so connecting lead resistances are comparable in value. For this reason in accurate work, special bridges, see Figure 8, are used in which extra extension leads are connected to the sensor element to balance out the effect of leads. The three lead bridge (Callendar-Griffiths) suffices for general industrial plant control (potentiometric resistance recorders have three lead connections built in) but for standards work, a Mueller bridge (devised in 1939) is used. To give an idea of current sophistication, bridges can now be used to measure the hundred ohm value to 1μΩ. Special precautions, such as the use of ac excitation with reactance instead of resistance elements, and temperature control of components and switch contacts to 0.01 deg.C are employed.

Platinum is the metal used for sensors in IPTS work. This was chosen because of its immunity to chemical corrosion, stability of resistance, high melting point and reasonably high specific electrical resistivity (ten times that of copper but far less than many resistance wires). Extreme care is exercised when winding the typically 100μm diameter wire onto stable formers as mechanical stress in the element could produce a strain gauge rather than a temperature sensor. The spiral is then housed in a tube filled with dry air to prevent contamination. Sensors are available in all shapes and forms and the cost is reasonable.

The temperature scale indicated by the resistance change of a platinum thermometer does not agree entirely with the IPTS fixed point scale. To overcome this, correction values are calculated using equations that have been developed to convert measured values into the desired IPTS values. This is the world standard for laboratory temperature measurement from −270deg.C to 660 deg.C and has also found extensive day to day use in less sophisticated forms where ultra-precision is not required. To speed up the calibration of service instruments, a sub-standard transfer thermometer is intercompared with one requiring calibration using a controlled temperature bath (like that in Figure 6) which is filled with water, oil or salt as the temperature demands.

Platinum sensors are reliable to at least 0.01 deg.C as far as IPTS reproduceability goes, but in cases of control where the absolute value is not critical, they can do far better. Probably, the best example to date, was in a calorimetry bath built by the National Bureau of Standards (NBS) in 1968. A most sophisticated control system using a commercial platinum sensing element, held water at the centre of the container to within 20 μdeg.C per day.

Not all resistance thermometers use a wire wound element, for that form of construction is often too large and has insufficient thermal response. For example, in the United States, several people have built sensors made from 1 mm of 630 nm diameter platinum wire to measure millisecond temperature variations in the atmosphere. Here the mounting is critical, to minimize external heat conduction to and from the sensor. Vacuum deposited films have also been employed.

Increasing interest in cryogenic temperatures (these near absolute zero) has resulted in methods specially suited to that region. One simple solution uses the common carbon composition resistor as the sensor. Calibration equations are needed to

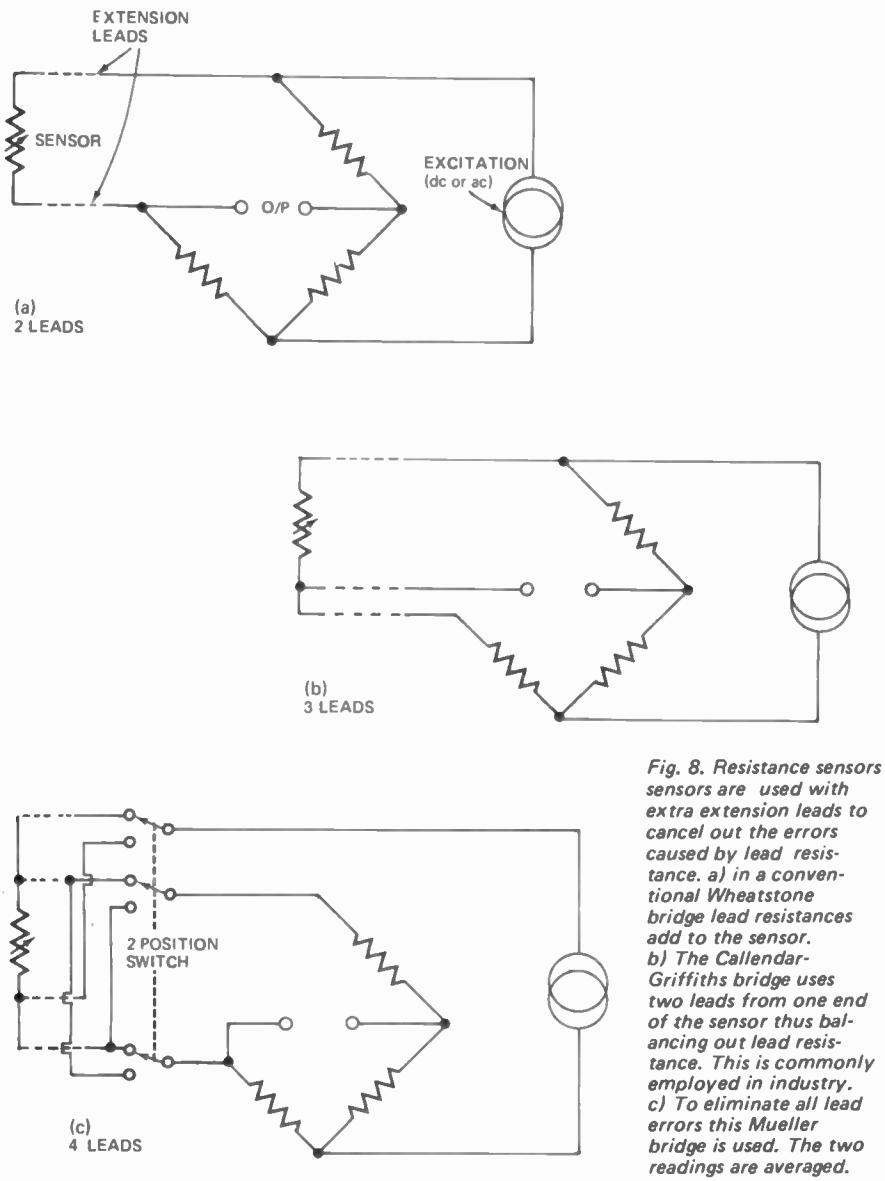

Fig. 8. Resistance sensors sensors are used with extra extension leads to cancel out the errors caused by lead resistance. a) in a conventional Wheatstone bridge lead resistances add to the sensor. b) The Callendar-Griffiths bridge uses two leads from one end of the sensor thus balancing out lead resistance. This is commonly employed in industry. c) To eliminate all lead errors this Mueller bridge is used. The two readings are averaged.

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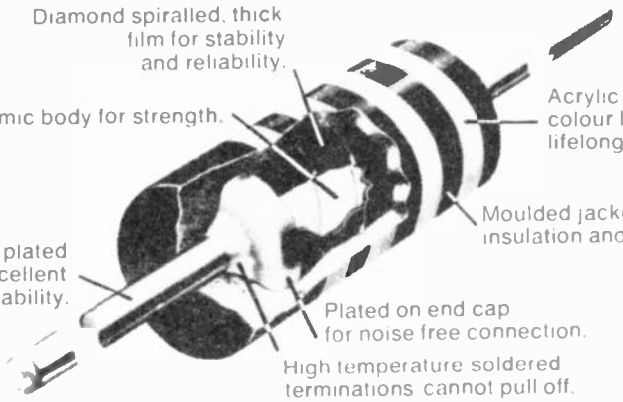

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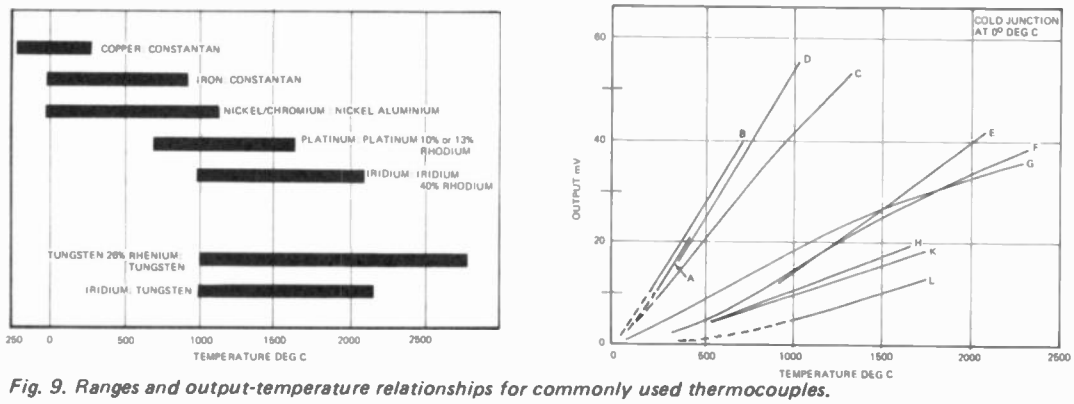


Fig. 9. Ranges and output-temperature relationships for commonly used thermocouples.

correct the actual readings in the 0.6 –5 deg.K region to 0.001 deg.K precision.

THERMOCOUPLES

In 1821 Seebeck discovered that when dissimilar metals were joined together to form a circuit of at least two junctions, a current would flow when the two junctions were at different temperatures. Peltier, in 1834, observed that the reverse also applied – passing a current through the loop caused one junction to cool, the other to heat. The Seebeck voltage is small being of the order of tens of microvolts per degree so the method is comparatively insensitive. By contrast thermistors can produce signals of millivolts per degree. A chart of the voltage output for common couples is given in Figure 9. Provided one of the junctions (the reference couple) is held at a constant temperature, temperatures measured with respect to it are absolute for no calibration is needed if the materials of the couples are known. Tables of values are available for the commonly used combinations which will enable the thermovoltage to be converted in IPTS values.

Thermocouples are formed by joining two wires together (twisted together often suffices, otherwise they are welded or clamped). Outputs vary from the couples and are not linear over the entire range (they closely follow a parabolic curve of which only the initial linear region is used). For this reason the senstitivity of a couple depends upon the temperature. Copper to constantan, for instance, gives 18μV/deg C at –183 deg.C and 62μV/deg.C at 400 deg.C. A couple made from two similar materials of different batch, copper from two different coils of wire for example, can generate as much as 10% of the voltage of a recommended thermocouple so care is needed in wiring. Special leads sold for connecting thermocouples as all connections are potential temperature sensors. For high temperature work, such as in furnaces, room temperature is adequate for controlling the temperature of the reference couple (temperature sensitive copper resistors are usually included in temperature recorders to allow for ambient changes). For ambient temperature operation, however, the reference couple must be better controlled with either a simple ice bath (miniature controlled Peltier units are available) or a special temperature tracking power supply that simulates a couple at the ice-point.

The advantages of thermocouples are their low cost, extremely wide temperature range (with different materials they cover from absolute zero to several hundred degrees Celsius) but the main feature is often the small size possible which enables millisecond response times to be realised.

The simplest way to measure temperature by thermocouple is with a milli-voltmeter and a set of tables. Although the circuit draws current to drive the meter, the resultant Peltier effect is negligible. For more precise work, potentiometers are used to determine the unloaded voltage. It is possible to resolve to 10nV with a good potentiometer so thermocouples are useful to 0.001 deg.C but great care is needed at such sensitivity to eliminate stray thermoelectric effects. As with resistance sensors, the universal demand has caused manufacturers to provide a wide range of hardware for applying thermocouples. Self balancing recorders are available that display temperature directly provided the correct couple is used. In these the pointer/pen is driven by a powerful, but crude motor which also drives a coupled potentiometer. If the potentiometer output does not balance the thermocouple signal, the error between the two is amplified electronically and used to drive the motor accordingly. The system rapidly balances and by this expedient the recorder is made extremely robust whilst retaining full scale sensitivity of a few millivolts.

To increase the sensitivity, several couples (a thermopile) can be joined in series so that more than one couple is measuring temperature. There will, therefore, be more reference junctions also. For example, to test the NBS water bath mentioned earlier, a thermopile was placed in the fluid and the reference pile in the centre of a fluid filled, large size, dewar flask that provided a time constant of many hours to the reference temperature. By this means they were able to verify the short-term stability, the thermopile senstivity being limited by electronic resistance noise to an equivalent temperature of less than 1μdeg.C. ●

To be continued . . .

EQUIPMENT NEWS

SNAP TOGETHER MULTIMETER

New from Hewlett-Packard is the Model 3470 Measurement System. It consists of a 4½-digit solid-state Display Module, Model 34740A, and a variety of plug-ons. Multimeter plug-on, Model 34702A, combined with the display module, is a digital multimeter with 4 full digits plus 100% over-ranging. It has 4 ranges of both ac and dc from 1V to 1000V full scale, and 6 ranges of ohms from 100 ohms to 10 megohms.

DC accuracy is claimed to be ±(0.03% of reading + 0.01% of range) on all ranges. AC measurement frequency range is claimed to be 45 Hz to 100 kHz, with accuracies of ± (0.25% of reading + 0.05% of range) from 45 Hz to 20 kHz. From 20 kHz to 100 kHz, accuracy is ± (0.75% of reading + 0.05% of range).

Also available is a DC Voltmeter Module, Model 34701A, with the same four ranges and accuracies as the dc section of the multimeter module. With the display module and the dc section plugged together, the instrument is a dc digital voltmeter.

Either the DC Voltmeter or Multimeter module is plugged on to the bottom of the Display Module to make up a complete instrument. Also available are two centre section modules, Model 34720A Battery Module and the Model 34721A BCD Module. Either of these is added between the top and bottom units resulting in a three-module instrument. Thus, the system can be converted for portable operation with up to 6 hours of continuous operation on a set of rechargeable batteries; or, with the BCD option, a non-isolated BCD output can be used to drive printers and other devices.

Printed-circuit boards are said to be easily removed for servicing. The modules can be combined without covers and power applied so that most parts are accessible for troubleshooting without using extender boards. An accessory test card can be plugged into the display section to make a comprehensive series of tests. Further details from:– Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, 3146, Victoria.

NEW DUMONT 60 MHz SCOPE LINE

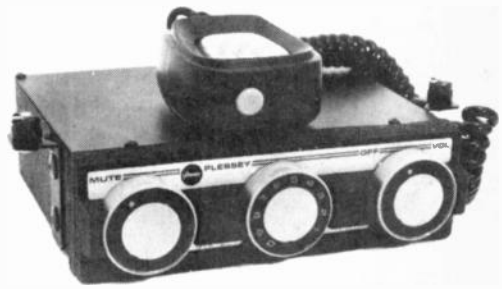
Dumont's new 1062 oscilloscope family is said to offer advanced performance, maintenance free construction and lower cost. Advanced performance is due in part to a unique triggering system which is said to offer flat *full band width* trigger sensitivity, settable trigger level on small signals and independence between position and triggering controls.

New features included are variable hold-off to allow synchronous triggering on digital word lengths, horizontal and vertical uncal lights, which are light-emitting diodes.

The 1062 is also available in a 5-1/4" rack-mount configuration or without delayed sweep.

Further details from:– Warburton Franki Adelaide, Brisbane, Hobart, Melbourne, Perth and Sydney.

COMPACT TWO-WAY RADIO FROM PLESSEY



Plessey have introduced a new mobile two-way radio, Series MTR40, which is said to achieve high performance, reliability and ease of servicing by the use throughout of solid state integrated circuitry and advanced layout.

The new Plessey mobiles are said to be extremely compact and to offer numerous safety features.

Either 8-10 or 25 watt operation is available and multi-channel types provide up to 10 channel operation.

The size is 7¼" x 2¼" on the front panel and six to eight and a quarter inches in depth and an attractively styled high performance 5½" x 4" loudspeaker assembly is separate from the control unit and can be mounted in the most convenient position for the driver.

Six versions of the single channel unit are available. Both lowband (70-80 MHz) and highband (148-174 MHz) operation is available together with the Calltone facility as required. A mute control knob and an on-off-volume control are the only controls required to operate the single channel units. A push button and red indicator light for the Calltone facility are added as required.

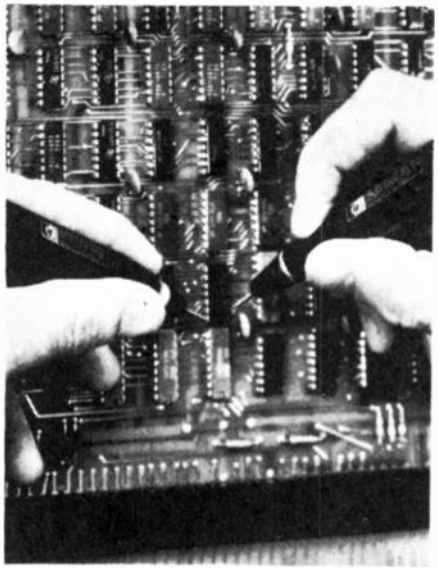
The Calltone silences the base station until a precise tone is transmitted from the mobile. Shared party traffic is eliminated, operator fatigue is reduced and the calling mobile gets immediate attention.

The multi-channel unit is available in four versions with low or highband operation as required. An additional control knob for channel selection with up to 10 channels available is located between the mute and on-off-volume control. The channel number selected on the channel select control is illuminated for easy reference.

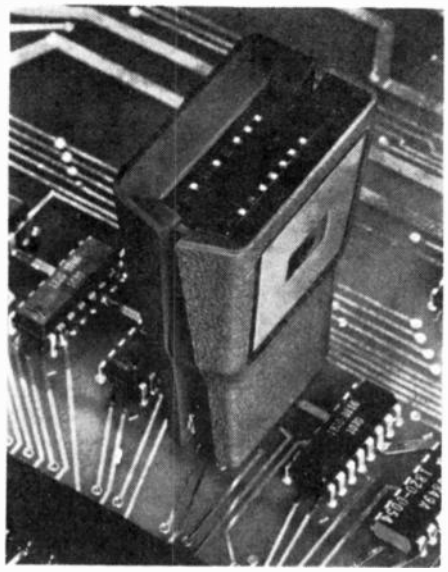
All MTR40 series control knobs are large, flat and impact absorbing. The control panel, the loudspeaker surrounds, and the microphone holding bracket, are padded with soft urethane. Nylon break-away screws are further safety features used in the quick release mountings that fix the unit in the vehicle.

Further details from:– Plessey Electronics Pty. Limited, 91 Murphy Street, Richmond, Victoria 3121.

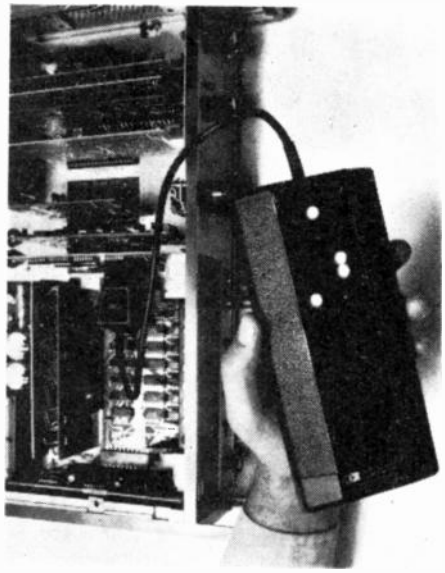
THE WORLD'S LEADING
IC Troubleshooters



Logic probe and pulser



Logic clip



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- Dynamic indicator of logic activity
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- No adjustments required
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- Safe overload protection

Model 10528A Logic Clip
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- Self-powered, self-contained
- No adjustments required
- Compatible with TTL/DTL logic levels

Model 10529A Logic Comparator
- Dramatically cuts troubleshooting time
- In-circuit IC testing with no unsoldering
- Simple to use with no adjustments
- Dynamic errors stretched and displayed
- Compatible with TTL/DTL logic levels
- Self-powered

10526T Logic Pulser
- In-circuit stimulation without unsoldering
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- Greatly simplifies digital troubleshooting
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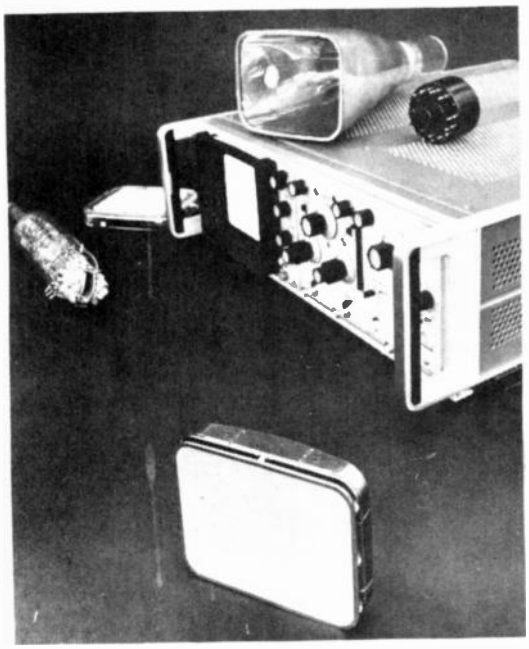
EQUIPMENT NEWS

HIGH SPEED STORAGE CROs



The fastest writing speed yet achieved in *storage* oscilloscopes is claimed by Hewlett-Packard. A new option for its recently introduced Model 184A variable-persistence scope is said to produce a writing speed of more than 400 centimetres per microsecond, at least twice that of any other possible choice.

Superspeed writing is achieved in the central part of the oscilloscope's graticule, as is common in such scopes. This area, then, is calibrated into a sub-graticule of 8 x 10 half-divisions. The central 8 x 10 sub-graticule scheme is unique to the HP instrument, the company states. Nor is resolution lost: in the high-speed mode, scan is automatically reduced, and so is cathode potential, so spot size is cut, and resolution in the reduced-scan region is as good as in normal full-scale operation. Automatic scan reduction likewise assures that the high-speed event of interest will positively fall inside the high-speed writing region of the display.

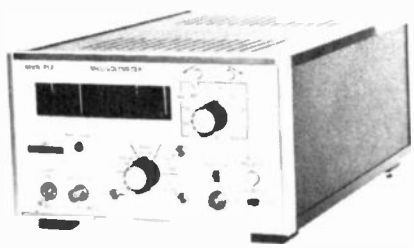
The HP 184A is likewise the least costly of the very fast-writing *storage* scopes now available, it was said. The Model 184A basic mainframe's writing rate is specified as 100 cm/microsecond. Option 005, increases the writing rate to 400 cm/microsecond.

The superspeed scope uses no new principle, operating like all previous HP variable-persistence scopes on the interaction between two meshes near the viewing screen. Increased speed is the consequence of processing improvements.

The Hewlett-Packard Model 184A is the latest in a chain of variable-persistence oscilloscopes produced by the company. It accommodates plug-ins for the firm's Model 180 series, with frequency response ranging up to 100 MHz. The main difference between Model 184A and the previously-offered Model 181A scopes is improved writing speed.

Further details from:– Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Victoria 3146.

SCHLUMBERGER/CRC RF MILLIVOLTMETER



The Schlumberger/CRC Digital RF millivoltmeter model MVN 713 measures low level ac voltages from 10mV to 300V in 10 ranges over a frequency range 20Hz to 10MHz with a claimed accuracy of .1% of reading ± 1 digit.

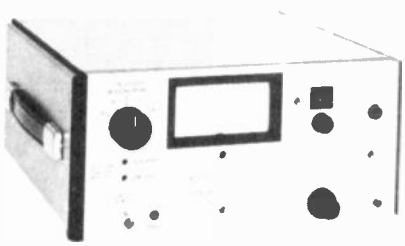
A resolution of 1 part in 1500 with 10uv sensitivity is offered and display is either voltage or decibel as selected via push buttons.

Both Analogue and BCD output are available and in addition the instrument may be used independently as a wide band amplifier.

Areas where it may be of particular interest will be for evaluation of filters, attenuators, response curve changes and gain measurement.

Further details from:– Schlumberger Instrumentation Australia Pty. Ltd., P.O. Box 138, Kew, Victoria. 3101.

LOGARITHMIC LEVEL METER



With this new WILTRON instrument, the law of a standard diode detector is converted to a linear dB scale. This provides a linear dB measurement range of –40 to +20 dBm with a claimed accuracy of ±0.5dB using any general purpose RF detector.

Applications include 60 dB range transmission gain and loss measurements also return loss measurements over a range limited only by the directivity of the VSWR bridge used.

Swept frequency measurements can be made using an oscilloscope or XY recorder as a readout. For CW operation the internal meter is used. In both cases the measurement range is 60dB with a discrimination of less that 0.1dB.

Further details from: Jacoby, Mitchell & Co. Pty. Ltd., P.O. Box 2009, North Parramatta, N.S.W. 2151.

THE 'PEAK' CT300 CLAMP TESTER

A new versatile instrument is available from H. Rowe & Co. Pty. Ltd. for measuring amperage and resistance with one tester. A maximum voltage range of 600 volts and current range of 300 amps, together with ease of operation, are claimed for the 'PEAK' CT300.

Measurement Ranges.

AC Current 5 ranges 6 amp, 15 amp, 60 amp, 150 amp, 300 amp.

AC Voltage 3 ranges 150 volt, 300 volt and 600 volt

Resistance to 1kΩ

The unit has a self-contained battery together with zeroing potentiometer for rapid resistance measurement. Protection is provided by internally mounted fuses. The measurement scales are colour coded for ease of reading. Current Black; Voltage Red; Resistance Green.

When testing in a dark or awkward location, the meter stop button is depressed and the reading held on the dial until cleared by the operator. The instrument is supplied complete with carrying case and test leads.

Further details from: H. Rowe & Co. Pty. Ltd, all states.
Brisbane, Sydney, Melbourne, Adelaide, Perth, Launceston.

An instrument for TV servicing that is ...keyed to COLOUR

NEW TAYLOR 68 AM MK. 2 SIGNAL GENERATOR

A new and improved version of the popular 68 AM Signal Generator now housed in a modern steel case which, with internal screening, issues very low levels of spurious radiation on all bands. An extended frequency range of 100 kHz to 240 MHz is covered in 8 bands. A redesigned attenuator ensures accurate repeatable settings when used in conjunction with the RF level indicator. Internal amplitude modulation is 30% at 1kHz. Service engineers will appreciate the top band reliability and accuracy of the 68 AM mk. 2 . . . and its lightweight of 4 lbs.

Price: $197.00
PLUS SALES TAX

For full details on this "keyed to colour" instrument contact:

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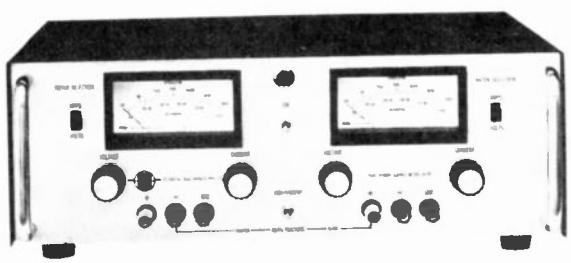

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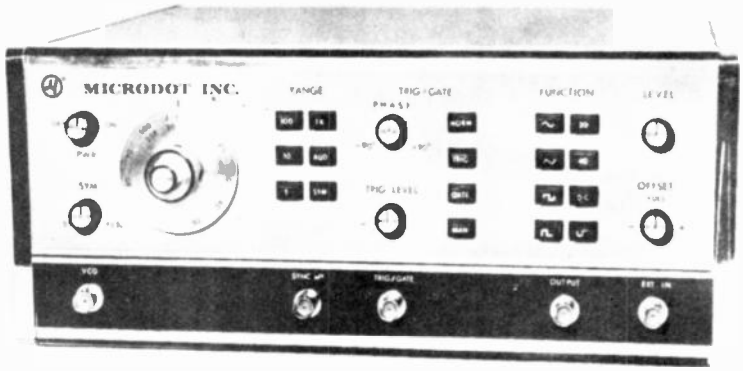
30 Ross Street, NEWSTEAD, 4006, QLD. — Phone Brisbane 52 2211.

EQUIPMENT NEWS

FUNCTION GENERATORS USE "QUAD SWITCHING"



A new line of benchtop function generators featuring an exclusive "ECL Quad Switching" technique for higher performance and cleaner response has been introduced by Microdot Inc. The Series 500 offers the lowest price available on the market. The three units in the new line are Model 501 (5 MHz trigger/variable start-stop), Model 510 (10MHz VCF generator), and the Model 511 (10 MHz trigger/variable start-stop).

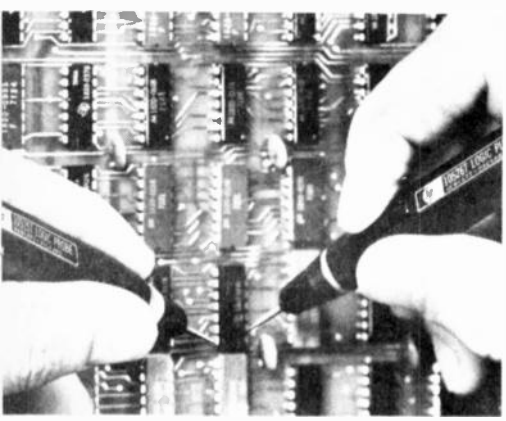
Output waveforms are sine, triangle, pulse, ramp, squarewave, and dc modes.

The new 10 MHz generators feature a super-fast 2500 V/us bipolar linear output amplifier capable of handling pulse widths of 50 ns at 50 percent duty cycle, and rise and fall times of less than 10 ns (7 ns typical).

The instruments provide 1000:1 VCF sweep capability on the main dial; 20 Hz-20 kHz special audio range; 5-95% variable symmetry control; and variable start/stop triggering at up to 10 MHz.

Details: DC Electronics Pty. Ltd., 32 Smith Street, Collingwood, Victoria 3066.

PEN-SIZE PULSE GENERATOR AND LOGIC PROBE



Either of two new logic test devices from Hewlett-Packard is a useful test instrument. Together, they form a stimulus-response test set with a size no more than that of two pens. One device is a mini pulse generator, the other a new test probe that makes sense out of the signals in logic circuits.

The Logic Pulser, Model 10526T, without unsoldering or otherwise opening the tested circuit, automatically drives any node to the opposite state – "low" nodes go "high," and "high" nodes go "low" for 400 nanoseconds. With the Pulser's very low source impedance (2 ohms) and high current delivering capacity (0.75 ampere), it can reverse the state of any node, even those that are highly noise resistant. However, the pulse is sufficiently short to prevent damage to the tested circuit. Touch the node, then touch the Pulser's button, and the circuit is pulsed. The Pulser automatically selects the correct polarity. Hold the Pulser on the circuit as long as it's convenient; output impedance is above 25 kilohms, as long as it's not pulsing.

A new Logic Probe, Model 10525T, will detect bad levels and open circuits, and will capture "high" and "low" pulses as short as 10 nanoseconds, whilst maintaining input impedance above 25 kilohms. Display is unambiguous – it's a ring of light around the base of the Probe. An unlit lamp means the state is "low", full brilliance means it's "high" and half brilliance indicates an open circuit or bad level. A blinking light means there's a pulse train running (up to 50 MHz). Short pulses (down to 10 nanoseconds) of infrequent occurrence are stretched to 50 millisecond "blinks" for clear visibility. The power supply input is protected to ±7V, and the probe input to ±70V continuous, ±200V transient. The Probe may be used on other logic families than DTL and TTL, so long as the threshold voltages are similar. It can be used without the Pulser by letting the digital system under test supply its own stimulus. With the Pulser, however, input-output relationships in each IC can be instantly determined.

Further details from: Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Vic 3146. Other branches in Adelaide, Brisbane, Canberra, Perth Sydney, Auckland and Wellington.

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with a new DMM that out-classes all competition

$715. That's the full price for complete multimeter capability: 5 DC ranges, 4 AC ranges, 5 ohm ranges.

4-DIGIT LED. 5th digit for 100% overrange, with leading zero suppression. Easy reading, reliable, cooler.

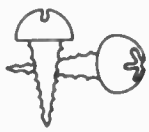
BATTERY CHECK. Shows operating hours remaining. When battery is low, automatic shut-off prevents wrong reading or battery damage.

AUTOMATIC BRIGHTNESS. The LED self-adjusts intensity to ambient light conditions.

RUGGED. Virtually unbreakable case. Weatherproof. Reliable for roughest field use. Won't quit.

ONLY 7½ LBS., with self-contained battery pack. Compact and lightweight for easy use . . . anywhere.

GOOF-PROOF. Exclusive cam-interlock absolutely prevents mis-matching of range and function.

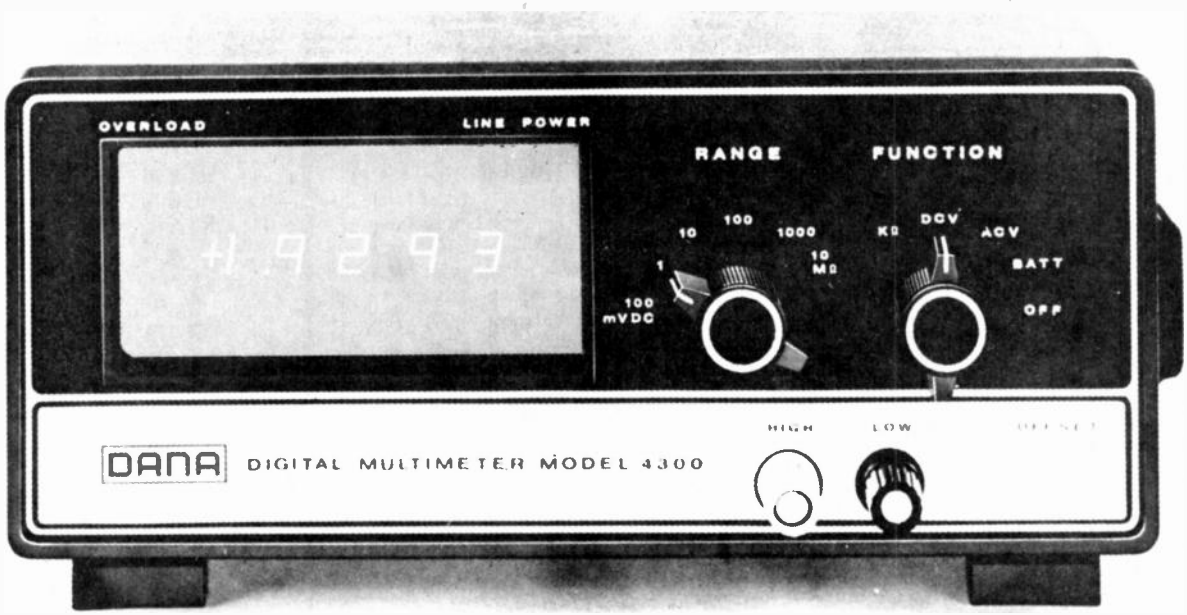


EASY ACCESS. Just loosen 2 screws to remove case. Display and battery pack plug-ins for easy, fast replacement or repair.

SPARE FUSE. Fuse box has no-shock safety interlock. Never leaves you dead in the field.

NO CREEP. Non-slip-grip feet won't let this DMM slide away.

So, before you buy any old standard DMM, check out this new Dana Model 4300 Multimeter. It has all the performance specs you need . . . plus all these features designed to make your job easier and safer. Write for literature on Dana Model 4300 today. Or phone any of the numbers below.



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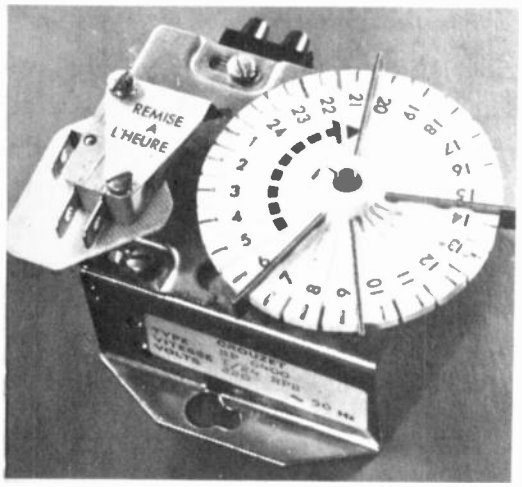
COMPONENT NEWS

SIMPLE TIME OF DAY PROGRAMME SWITCH



Crouzet have released in Australia, a simple time of day programme switch which, it is claimed, will satisfy many industrial needs.

Basically, the timer consists of a synchronous motor driven cam which is divided into 24 segments into which can be clipped simple micro-switch actuators. The timing cycle is varied according to the shape of actuators selected.

The cam is driven by the motor through a clutch so that the initial time setting can be simply achieved by manually rotating the cam to the position desired.

The standard cycle time is 24 hours and actuators are supplied to provide operating periods of approximately 1/60th and 1/25th of the cycle.

This timer is most economically priced, it is claimed, and will find wide applicatien in many locations as an alternative to the more conventional type of switch now being used.

Further details from:– the sole Australian Agents, Relays Pty. Ltd., Valetta Building, Campbell Street, Artarmon NSW.

NEW SHIFT REGISTER FROM SGS

SGS, announces the availability of a new dynamic shift register, the M 125. This has a complexity of 512 bits arranged in two sections of 256 each. One section is provided with recirculating logic which gives the device great flexibility when used as an accumulator.

The two sections can be connected in series to perform the function of a 512 bit accumulator. This is particularly useful for renewing fading displays such as cathode ray tube character generator systems.

The M 125 uses a 4-phase logic system for dynamic operation, where two phases are internally generated and the other two are to be provided externally.

Dynamic operation permits very low power consumption (230 μW per bit) and high frequency operation (1 MHz) it is claimed.

Outputs are said to be able to directly drive the CCSL family because of a very low output buffer impedance. Furthermore the device can drive, or be driven by, elements in the HLL family since their voltage swings are compatible.

Inputs are said to be protected against electrostatic charges. The M 125 comes in a TO–100 package and is guaranteed over the temperature range 0 - 70^{o}C.

Further details from: Warburton Franki, P.O. Box 182, Chatswood 2067.

PNP COMPLEMENT TO 2N3055

As part of their newly released power range, Fairchild have available a PNP complement to the 2N3055. It is designated AY9149 and is claimed to offer all of the features in the Silicon Bimesar process – o Large safe operating area o Extremely rugged devices even under large overload conditions o High current capability o Devices which can be protected with a rapid acting fuse o Low junction to case thermal resistance o Maximum package dissipations o High power handling capability o Low saturation voltages.

Products in the range are – 115 Watts 2N3055 NPN, 115 Watts AY8149 NPN, 115 Watts AY9149 PNP, 115 Watts AY8150 NPN, 115 Watts AY9150 PNP, 35 Watts AY8170 NPN, 35 Watts AY9170 PNP, 35 Watts AY8171 NPN, 35 Watts AY9171 PNP, 25 Watts 2N3054 NPN, 10 Watts AY8139 NPN, 10 Watts AY9139 PNP, 10 Watts AY8140 NPN, 10 Watts AY9140 PNP.

Further details from:– Fairchild Australia Pty. Ltd., 420 Mt. Dandenong Road, Croydon.

NEW TAG CAPACITORS

A technological agreement between Sprague Electric Company and Nichicon Capacitor Company has enabled Sprague to now market a low cost tag tantalum capacitor.

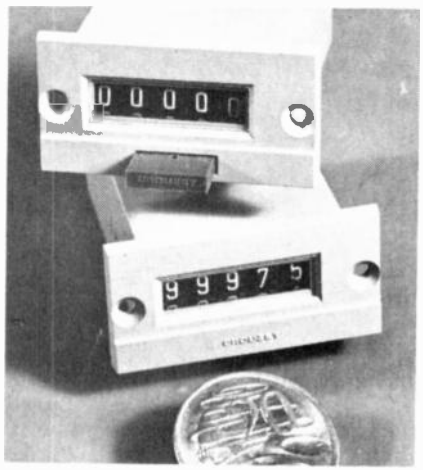
Designated type 196D, this capacitor is said to offer standard tolerances of ±10% and ±20%, and is available in 4V through 50V ratings. Capacitance values of .1MFD to 330MFD are available.

To facilitate using these units, Sprague have indicated the value on them by branding, rather than by color coding.

Initial stock of the 196D at Total will cover twenty-nine values in the ± 20% tolerance.

A new data sheet, which includes a listing of the stock values, is now available from:– Total Electronics Sydney, Melbourne, Adelaide.

CROUZET MINIATURE COUNTERS



Crouzet have released a new impulse counter which should be ideally applied to the electronic field because of its relatively small size.

The unit's overall dimensions are 24mm x 48mm x 78mm and it has a count capacity of 99,999.

Two versions are available, one being with manual reset, Type 87.661 and the other without manual reset, Type 87.660. Both can be provided with a variety of ac and dc coils in the standard voltage ranges.

Further details from:– the sole Australian Agents, Relays Pty. Ltd., Valetta Building, Campbell Street, Artarmon NSW.

93415 –TTL ISOPLANAR MEMORY.

The 93415 RAM is the most complex monolithic bipolar read/write memory ever made, the manufacturer claims.

This self-contained subsystem is claimed to feature 30ns chip select access time, open collector (expandible) output, static TTL operating and decreasing power dissipation with rising temperature. Available now in prototype quantities in 16-pin hermetic DIP.

What this means to designers of high-speed digital systems is that for the first time they have available a major TTL memory building block that can operate at speeds compatible with those of their systems' logic.

Because it's static, the 93415 is simple to use, requires no complicated peripheral electronics and because of its functional density and capability, the 93415 gives the designer a fine opportunity to realize significant cost savings by 1) reducing package count, 2) reducing circuit board number and size, 3) reducing number of connections, 4) increasing system reliability.

Further details from:– Fairchild Australia Pty. Ltd., 420 Mt. Dandenong Road, Croydon.

COMPONENT NEWS

MODULAR CONNECTOR KIT

A new addition to the McMurdo do-it-yourself connector kit range is the SLIMLINE modular connector kit, which is supplied in a convenient pack, complete with assembly instructions and a chart for ordering production quantities.

The kit contains mouldings, contacts, a handle with cable clamp and an extruded plastic cover. The connector mouldings and cover supplied in the kit are easily cut into many different lengths to suit the exact requirement for the application.

The SLIMLINE kit is extremely useful for prototype developments and allows many connector combinations to be made (from 2 to 40 ways). Chassis, P.C. Mounting, or in-line (with cover) types can be made from the parts supplied. SLIMLINE connectors also match the pitch of 0.2" pitch "veroboard".

Further details from: McMurdo (Australia) Pty. Ltd, 17-21 Carnish Road, Clayton, Victoria, 3168

SYNCHRONOUS CMOS UP-COUNTERS

Motorola has introduced two CMOS logic up-counters, the MC14518 and the MC14520, for counting applications at rates up to 6 MHz. An internal synchronous counting design reduces propagation delay where many counting stages are required.

The MC14518 provides a dual, BCD up-counting function while the MC14520 offers a dual, binary up-counting capability. Both up counters consist of two, identical, independent 4-stage counters.

These counter stages are type-D flip-flops that have separate and interchangeable clock and enable lines. This allows the up-counters to be incremented on either positive-going or negative-going clock signal transitions.

Both the MC14518 and the MC14520 come in two versions, the AL version or the CL. The AL designated devices can operate, it is claimed, from a 3 V to 18 Vdc supply over the temperature range of -55° to +125°C. The CL versions operate from a supply voltage range of 3 V to 16 Vdc within -40° to +85°C temperatures.

Besides the high, 6 MHz, counting rate, these counters are said to offer the following specifications. Noise immunity is typically 45%, and guaranteed at $\geqslant$30% of supply voltage. Quiscent power dissipation is 1 μW typical, and input capacitance is rated at 5 pF.

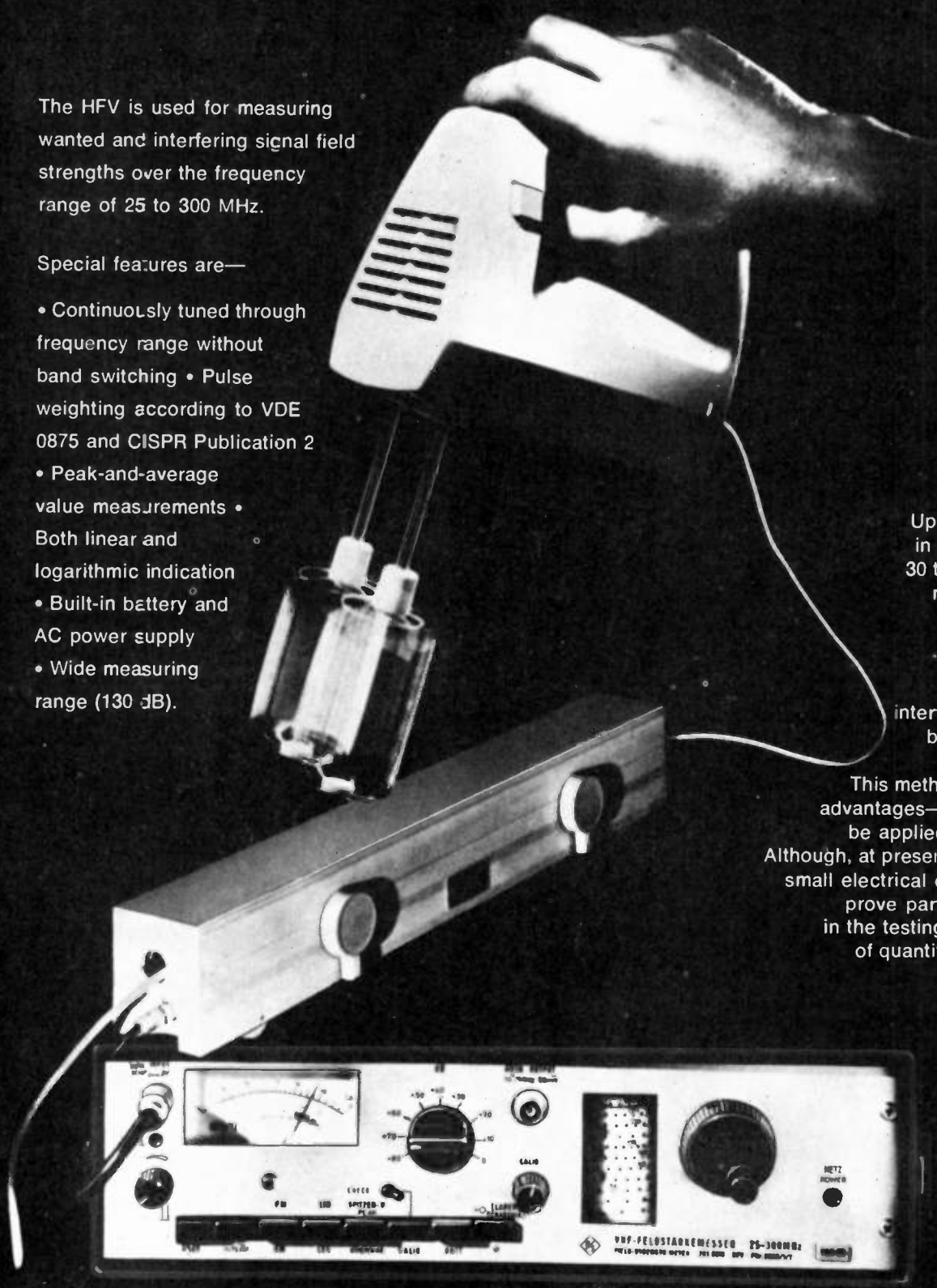
The enable function allows multiple stage synchronous counting when ripple enable or parallel enable functions are applied to higher order stages. OR cascading can simply be accomplished by stage-to-stage ripple clocking.

Further details from: Motorola Semiconductor Products, Suite 204, Regent House, 37-43 Alexander St, Crows Nest 2065.

The HFV is used for measuring wanted and interfering signal field strengths over the frequency range of 25 to 300 MHz.

Special features are—

• Continuously tuned through frequency range without band switching • Pulse weighting according to VDE 0875 and CISPR Publication 2 • Peak-and-average value measurements • Both linear and logarithmic indication • Built-in battery and AC power supply • Wide measuring range (130 dB).



Up to now, interference in the frequency range 30 to 300 MHz has been measured in terms of field strength. A new method has now been developed in which the interference is measured by means of a special absorbing clamp. This method has considerable advantages—it is simple and can be applied in enclosed areas. Although, at present, only applicable to small electrical equipment, it should prove particularly economical in the testing and quality control of quantity produced articles.

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AD33

AMATEUR RADIO

Roger Harrison VK2ZTB

THE STATE OF THE ART

In Australia today, amateur radio enthusiasts are actively exploring 'state of the art' techniques and communication methods. These include earth satellite communications, moonbounce, meteor scatter, tropospheric and weak signal detection. Amateurs are also experimenting with television techniques including high resolution black and white systems, colour transmission and slow scan TV. In addition a number of amateurs are exploring UHF and SHF circuit techniques and others are currently researching propagation in different fields.

This column will bring you news and details of these activities – and the people involved. In so doing, we hope to stimulate further activity and to provide a medium by which a useful exchange of information can take place.

In short this column will be a 'melting pot' cum 'information bureau' where those who are working within the definition of amateur radio (i.e. experimentation in communications solely out of personal interest) can gain and exchange information and publicity.

On behalf of the N.S.W. Division of the Wireless Institute of Australia, it gives me great pleasure to introduce this column written by Roger Harrison VK2ZTB, who I am sure is well known to many of you.

As the Wireless Institute is a national organisation, the coverage of this column will also be national and will concentrate on those groups and individuals who, today, are exploring the frontiers of not only amateur radio, but communications in general.

Mike Farrell
Secretary
N.S.W. Division of the Wireless Institute of Australia

AMATEUR SATELLITES

SINCE the successful launch and orbiting of the AO-5 amateur satellite (built by the Australis-Oscar group in Melbourne with support from the Wireless Institute of Australia), many amateurs have constructed equipment for satellite communications. A great deal of activity is being generated by the coming launch of AO-B in November. Built by the American AMSAT group this is a linear translator with an uplink channel 100 kHz wide extending from 145.9 to 146.0MHz and a downlink channel in the 28MHz band. Relatively modest equipment is all that is necessary to use this free-access satellite. Measurements on the prototype indicate that a transmitter running 7 watts output on 144 MHz, will drive the 28 MHz downlink transmitter to full output producing a signal of -150 dBW at a dipole on the earth at 2050 miles slant range.

The Australian built AO-C, 432 MHz to 144 MHz translator satellite will most likely be launched sometime late in 1973.

MOONBOUNCE ACTIVITIES

On 1-1-72, Ray Naughton, VK3ATN contacted K6MYC in California and VE7BQH via moonbounce on 144 MHz. This was the first Australian to Canadian contact via moonbounce. (Ray Naughton has been experimenting with this form of communication for seven years with quite a deal of success. He won the 1966 ARRL Technical Merit Award for the first moonbounce contact from Australia to U.S.A. with Mike K6MYC.

Using largely homemade equipment and running only 150 watts input with stacked semi-moveable rhombic antennas, his successes are indeed a great achievement. Ray is currently constructing 432 MHz and 1296 MHz equipment for moonbounce work.

A group of amateurs from Wollongong, N.S.W. forming the Dapto Moonbounce Project has spent two years or more preparing equipment and experimenting. On 19.4.72 they were partially successful in contacting WA6HXW in California. However, no reports were exchanged as the Dapto group, VK2AMW, did not realise that reception of a full call sign, in parts, during one transmitting session, constituted a contact.

The group have refurbished the old CSIRO radio astronomy facilities at Dapto for their project. They run 400 watts output to a 30ft dish on a polar mount with phase-locked transmitter frequency control. The receiving system front end is solid-state with a 3dB noise figure.

SHF

A number of Australian amateurs are working in the region above 3000 MHz. Foremost amongst these people are Des VK5CU (now VK2AHC) and Barry VK5ZMW. On 30.12.71 at 1245 CST, using a frequency of 10GHz, Des VK5CU (located portable at Black Top Hill), Elizabeth, S.A. contacted Barry VK5ZMW portable at Kulpara, South Hammocks – a distance of 61 miles – thus setting the Australian distance record for the 10 GHz band. The equipment was homemade and was all solid-state except for the klystrons. Output power was 100 MW; antennas were 24 inch dishes. A 144 MHz link was used for liason.

UHF

The amateur UHF bands are sparsely populated but much original work is being done here. Two Sydney amateurs, Dick VKZBDN and Bill VK2ZAC have been working on 2300 MHz equipment with some success. Both tried receiving transmissions from Apollo 16 with disappointing results. Bill VK2ZAC heard telemetry signals only.

Ian VK3ALZ, in Melbourne, has developed a design for a Yagi antenna having quad (square) elements for 432 MHz. A gain of 19dB can be achieved with only a 12 foot boom length. He has a similar design working on 144 MHz.

The 1215-1300 MHz band is now being used by many more amateurs. Ron, VK3AKC from Geelong (Vic) has worked on this band for some years. He holds the Australian distance record for this band together with VK7ZAH (Tasmania). They worked a path of 273 miles, employing tropospheric scatter and using largely home built equipment. Ron VK3AKC has developed a high power amplifier for use on 1296 MHz.

(Continued page 104)

TV

Slow Scan TV (SSTV) has a large number of exponents in Australia and is a rapidly growing section of our hobby. Among the chief exponents are John Wilson VK3LM/T, Wally Porter VK3ABM/T and Mac McKibbon, VK3YEO/T. A list of recommended standards has been drawn up by John, VK3LM/T which was published in an article by him on SSTV in the January issue, 1972, of "Amateur Radio". Their system employs frequency-shift modulation with a transmitted bandwidth no greater than 6kHz for DSB and 3kHz for SSB transmissions.

Resolution is 120 lines per frame with a horizontal sweep rate of 16.66 Hz and a vertical sweep of 7.2 seconds. There are a number of net frequencies used by SSTV experimenters, these being 3.650 MHz, 7.125 MHz, 14.230 MHz, 52.600 MHz and 144.675 MHz.

There are about 30 amateurs in N.S.W. engaged in colour and monochrome TV experiments. Vic Barker VK2ZVV has constructed his own PAL colour equipment and modified an AMPEX videotape machine for colour use. Vic, and Mac VK2ZIM gave a demonstration to a well attended meeting of the VHF and TV group of the N.S.W. Division of the WIA in June.

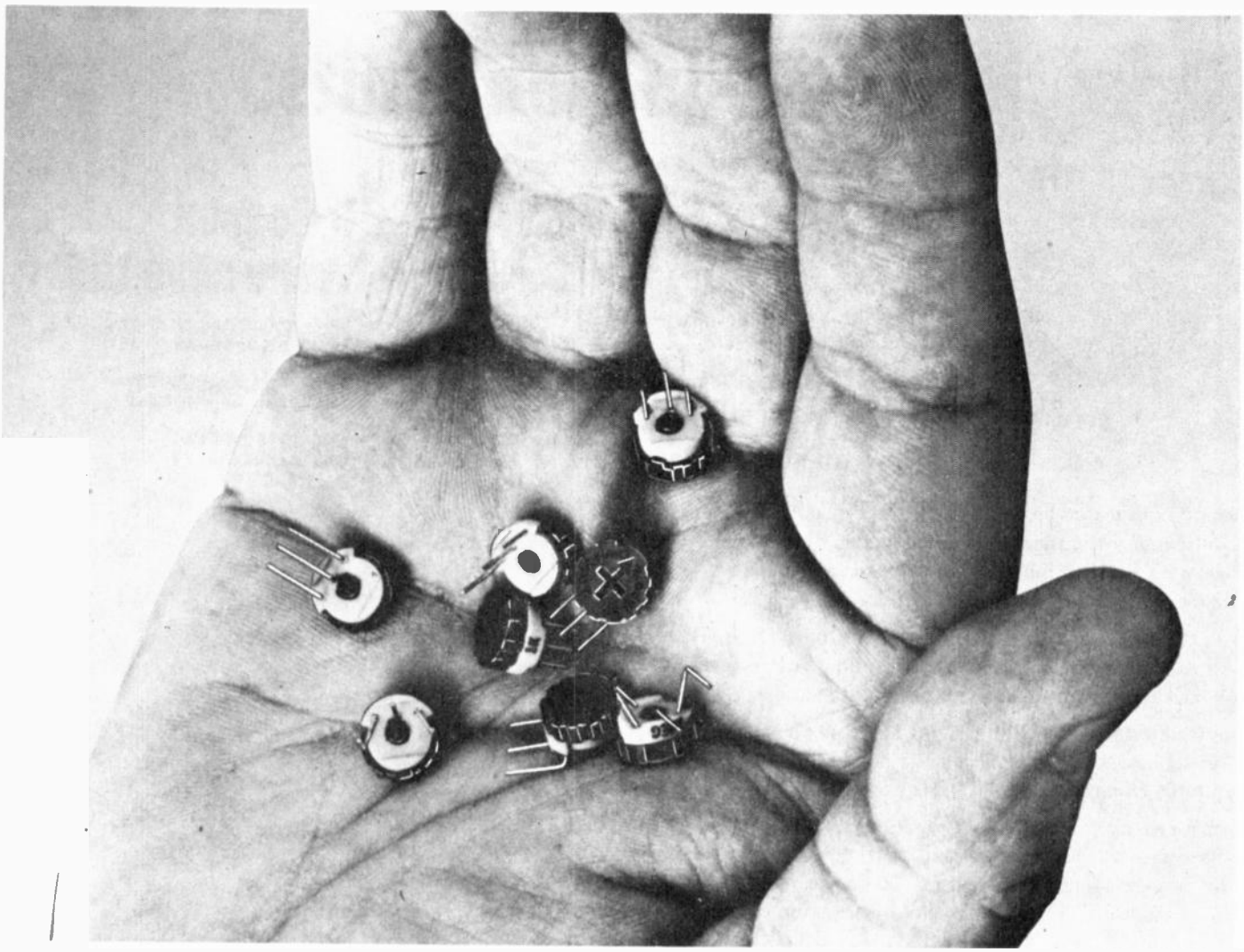
In Victoria, Max, VK3BAX/T and Ivan, VK3BAZ have been receiving the TV transmissions of Bill VK4ZHT/T located portable at Bell Park (Vic). Frequencies used were the standard ATV Channel 1, video on 426.25 MHz and audio on 431.75 MHz.

METEOR SCATTER

Wally Watkins, VK5ZWW has been conducting meteor scatter communication experiments on 52 MHz for more than 18 months with a great deal of success. This form of communication employs scattering of signals from meteor trail ionisation in the upper atmosphere at a height of about 110 km.

Schedules with VK8AU, Tennant Creek (now VK3AUU) VK2ZUJ (Sydney) VK3AUU and VK3ANP (Vic) and VK7ZGJ (Tasmania) have all been successful. Equipment is not sophisticated and powers around 100 watts are employed. Mostly, SSB voice communications is used. Some people are setting up to conduct 144 MHz meteor scatter experiments considering the successes of U.S.A. amateurs in this field.

The activities described above are certainly not all amateurs have achieved in the past year or so, but certainly indicate that amateurs can and do use state-of-the-art techniques and equipment and can contribute towards furthering the boundaries of communications techniques. ●



Helipot offers new covered cermet trimming potentiometers for low-budget projects

No longer is there much reason for using cheap wirewound or carbon trimming potentiometers – not when the new Helipot Series 91 Cermet Trimmers are available off-the-shelf for only a small amount more.

These single-turn, 9.6 mm (⅜ inch) covered trimmers are available in ten different mounting styles and 19 standard resistance values from 10 ohms to 2 megohms.

Covered construction helps protect against moisture, corrosive atmospheres, dust, oil and other contamination, thus giving you long, dependable performance.

Send now for complete data on these low-priced Series 91 cermet trimmers . . . the finest of their class. They're made for projects where your budget may be restricted but you can't compromise on performance.

For further information on these new trimming potentiometers from Helipot, contact:

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● MELBOURNE 69-0151 ● PERTH 61-8688 ● SYDNEY 648-1711

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TEAC's AN-60, AN-80 and AN-180 Noise-Reduction Units.

TEAC AN-60

If Rossini were alive today, he would set their specs to music.

Rossini once made this boast and could probably have delivered. But a recording of the music on the best of today's cassette or reel-to-reel machines with their inherent noise and hiss could never capture the clean, crisp sound of the Rossini laundry list.

With the introduction of TEAC's AN-180 Dolby* Noise-Reduction Unit, Rossini's Laundry Largo and just about anything else you record will have the same brilliance and luster as the original.

Our Dolby circuit removes machine and tape noise with such thoroughness that there is a signal-to-noise ratio improvement of 3 dB at 600Hz, rising to 5 dB at 1000Hz and 10 dB at 4K Hz and above.

Because we manufacture the ICs used in our Dolby circuit to extremely tight tolerances, ours operates at distortion levels of less than .3% — lower than many competitive units. So you see there is no question that you should have a TEAC Dolby Noise Reduction Unit.

We designed the deluxe AN-180 not only to Dolbyize fine decks, but to afford them features they might be missing.

TEAC
AN-80

It's actually a simultaneous record-playback control center with its own record and playback amps. It has built-in mike and line preamps that maintain mixing capability, or add this capability to recorders not so endowed.

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AMI 11

RECORDINGS... CLASSICAL

REVIEWERS: Tanya Buchdahl
John Araneta, C.M. Wagstaff.

SCHUBERT – Symphony No. 8 (Completed Gerald Abraham) Rosamunde overture – Charles Groves, Royal Liverpool Phil HMV OASD-2743.

The idea of an "Unfinished" finished seems particularly monstrous to most people. But after all, there are useful musicological resasons for it, and it is good to see a recording company letting us hear an example of such reconstructions.

Let me say straight away this is a strong performance of the Eighth, and if one objects very much, nothing prevents the lifting of tonearms after the second movement. But to begin with, I think this recording can at least be useful to dispel the far too many romantic notions associated with this work.

When one is able to hear the powerful Scherzo after the Andante and not just "read" it, you cannot help realizing that if this symphony had in fact been completed, it could have been a far more interesting work than the "Great". Also, no matter how many times one hears this work, it is marvellous, and would perhaps not have owed its uniqueness to those two extant movements. But it may also be tragically instructive to think that precisely after those movements, Schubert may have felt unable to live up to their achievement.

You may object to my dealing in "might-have-beens" but we do not object to this in the Art of Fugue, so why here? As I said there are useful musicological reasons for this "recorded" experiment. No musicologist would undertake the completion of any Schubert unless most of the work has been presumed done by Schubert himself. In this case, the crucial problem, the Finale, is presumed to be the great entr'acte from Rosamunde. As Gerald Abraham puts it himself, he is not the first Schubertian to hit upon this solution. The entr'acte is in B minor, scored for the instruments of the symphony, and we know Schubert did not have time to write an overture for Rosamunde and yet is supposed to have written the entr'acte.

Well, we can hear whether the theory holds good or not. The point is that it is not quite as effective to just hear the entr'acte after the Andante. Is the entr'acte a true finale or not? One can judge properly if one is able to hear what the Scherzo was like, or could have been like. Yet Gerald Abraham arbitrarily fills in the middle section of the Trio with an orchestral version of Der Liedende included in Rosamunde and I am afraid Abraham's insertion seems more inspired than Schubert's own Trio, at least after that arresting Allegro. But perhaps that is also because the insertion is based on finished Schubert but one can perhaps see one reason why Schubert did not go on with this movement.

I have to admit that after repeated listenings the entr'acte does not strike me as a convincing finale after all. It seems to me rather episodic, even operatic in character particularly the lyric episodes which have a curious similarity to similar episodes in the Magic Harp overture or as we commonly refer to it these days, the Rosamunde, a performance of which follows the symphony on this record. Others will disagree, and they will have the company of Tovey, Einstein, and Grove, among others. Or perhaps as Tovey put it, I am demanding a typical Schubertian finale for the Unfinished. We can hear for ourselves. Recording seems at times to be rather over modulated but nothing the controls cannot remedy. – J.A.A.

MOZART – 4 Horn Concertos – Alan Civil (horn), Marriner, Academy of St-Martin-in-the-Fields Philips SAL-6500 325. Barry Tuckwell (horn), Marriner, Academy of St. Martin-in-the-Fields HMV OASD-2780.

At first sight these records seem useless duplication on the part of Tuckwell, Civil and Marriner. Both Civil and Tuckwell have recorded these concertos twice before and Marriner is here to help both with their third recordings. On second thought, I suppose if I were a horn player and had to play this music, I would prefer to play with the Academy. But not being a horn player, admit that after that superb Brendel/Academy recording of two Piano concertos, I will have to have one of those recordings. How about the Violin Concertos?

To get to the point, however, I rather expected these performances not to be so dissimilar, having as they do the common denominator of the Academy. Well, they are very different. Civil/Marriner is bright, sharply accented, a very gallant performance – pure champagne.

Tuckwell/Marriner is more romantic and also serious, the bounce of the music underplayed. Comparing these, not surprisingly, Civil and Tuckwell's views have really not changed all that much. One suspects both horn players felt the Academy might be the deciding factor for the better. That seems true enough and it is perhaps a tribute to Marriner and the Academy that they can accommodate such different interpretations. I feel Civil's gallant approach benefits more from the Academy's backing, at least, the playing seems also more characteristic of the orchestra's ideas.

Oddly enough, Tuckwell/Marriner includes a harpsichord continuo, an unnecessary feature it seems to me, in this music. At any rate the general romantic tenor of Tuckwell/Marriner gives the harpsichord a curious irrelevant character. Each artist plays his own respective completions of K.371 and cadenzas. Tuckwell manages to include the unfinished K.494A. Different sounding instruments are used. Decide on the basis of technique? Civil tends at times to sharpness, Tuckwell flatness. If you are a horn fancier or player, no doubt, you will have both. Otherwise it will depend on what you think these concertos should sound like. Even the recordings reflect the tendencies of the performances. I myself will opt for the Civil, but honi soit . . . J.A.A.

BEETHOVEN: "Archduke" Trio (No.6) Op.97; Trio No 7 (1812). Daniel Barenboim, piano; Pinchas Zukerman, violin; Jacqueline du Pre, cello. HMV Stereo OASD 2572.

With such a collection of artists as this I expected more than I heard. The piano seemed to have by far the most interesting part and held my attention almost all the way through, but as Beethoven could not have been guilty of such an imbalance so late as Opus 97 and in a work of such obvious beauty and care of construction, it had to be a variance in the performance in the performers' quality (and I think a little too much piano from the technical angle, though otherwise the sound was excellent. Though the 1812 trio fared much better, Zukerman didn't really get around to showing us what he can do, and Jacqueline du Pre has played better in her time too. It comes as quite a surprise to hear her play without the fireworks and passion we are accustomed to (remember the Elgar concerto?) But the honours go to Barenboim who plays with complete involvement, demonstrating once again the mastery of Beethoven style (particularly the

CLASSICAL

Late Period style) that he has acquired in just the last few years.

It's by no means a bad performance, though it's not the best. I think that's still the Thibaud/Cortot/Casals recording of many years ago, which, despite hearing it on the original and very dusty 78s, was a magical (for want of a less corny word) experience. And it looks like it'll be a long time before we hear playing like that again. – T.B.

MOZART Symphonies Nos 35 "Haffner" and 40. March, K.408 No 2. Academy of St. Martin-in-the-Fields. Philips stereo 6500 162.

Since its inception as a recording orchestra in 1959, the reputation of the Academy of St Martin-in-the-Fields has grown until it is now recognized as being just about the best chamber orchestra in Europe.

As evidenced by this recording, one of a series of four which traces the chronological development of the classical Symphony from J.C. Bach through Haydn and Mozart to the young Beethoven, the Academy is truly a chamber orchestra. I have never heard an orchestra play with greater clarity and precision or with such perfect phrasing. Here are forty or so mucisians playing like a well oiled string quartet.

If anything they are too perfect, too clinically incisive; no longer identifiable as human agents. A strange reservation to have, but if you listen to the first movement of the 40th you may hear what I mean. It is perfect; technically, I cannot fault it; but it generates no emotion. The inner movements of the Symphony fare much better. Warmth and feeling are present as well as great playing, and the music is fully revealed. The andante is ecstatically beautiful, and the singing quality of the Menuetto is perfectly realised.

The theme of the finale is played without the accent at the top of the first phrase, thus endowing it with an air of mystery. The movement is well played except that there is a slight slackening of tempo in tuttis which creates the effect of bogging down.

Wherever possible, the Academy's director, Neville Marriner, has gone to the original score of these works in an attempt to reconstruct the original performance. For instance, this version of the "Haffner" is the 1782 Salzburg one which has no flute or clarinet parts in the first or fourth movements and has a fifth movement – the march.

While the "Haffner" cannot be compared to the 40th – it is not a profound work in Mozart's terms and was not meant to be – it is certainly beautiful music. Once again the performance here is well nigh perfect, but strangely lacking in character and involvement.

A good record to have for the sheer magnificence of the playing – recorded incidentally with the same technical excellence – and for the musicological interest of the original scoring. C.M.W.

BRUCKNER – Symphony No.6 (original version) Haitink, Concertgebouw Roch. PHILIPS 6500325.

This major symphony by Bruckner has never really caught up with the public. After recent performances of the work in Sydney, one heard the usual complaints associated with Bruckner works: too long, repetitious, poor invention, clumsy orchestral writing, etc. Bruckner, of course will never appeal to everybody and one must admit that even for the Brucknerite this symphony usually seems unduly difficult, if not a bit strange.

The problem here is not just that the work exhibits almost a catalogue of mannerisms, but more to the point, it is a very rare performance that manages to bring it off successfully. Those awkward Brucknerian rhythms in the first movement can be easily overemphasized and integration with the remaining elements of the movement must be just right or the totality suffers.

One recalls an old Swoboda record that at first sounded as if the first movement had been taped with a strong flutter or wow. I still think the tape did have some wow but not as much as the performance itself.

Strange to say, there are now two performances of this symphony on record that are nothing less than superb. The older Klemperer/Philharmonia for HMV remains, I think, the magisterial reading of this work. If you have ever been troubled by the first movement, especially, do listen to the Klemperer. The present Haitink recording certainly has better sound and I dare say, is the only other performance I have heard that is almost as convincing as the Klemperer. The difference is slight enough. In the first movement, Haitink does not quite manage to integrate those troublesome rhythms as Klemperer did but certainly the end result is close. While Klemperer's performance managed to have an almost religious devotion to the music, Haitink seems fiery by comparison, and careful as well not to completely smooth over any awkwardness which is certainly a characteristic of the music.

All in all then, a thrilling performance, very well recorded. – J.A.A.

CORELLI – 12 Concertos, Op.6. Solisti dell Orchestra "Scarlatti" Napoli Ettore Gracis (cond.) 3-DGG ARC 2710011.

We have needed an up to date recording of the complete Op.6 concerti and Archiv is to be commended for trying to fill in this gap in the catalogue.

It seems unfortunate then that the project has been entrusted to a group that plays well but also has little present day knowledge (or prefers not to use it) on the performance of baroque works. Which is to say this performance seems a bit romantic to suit Corelli: tempi are barely differentiated, rhythms not sharp enough, and the continuo hardly enterprising, to put it lightly. Ornamentation is also kept to a threadbare minimum.

Twenty years ago this recording might have served will enough, but not today. One looks to a Marriner or a Harnoncourt to do these works justice but it has taken long enough for this set to come along and I suppose it will have to do in the meantime. Fine sound and surfaces. – J.A.A.

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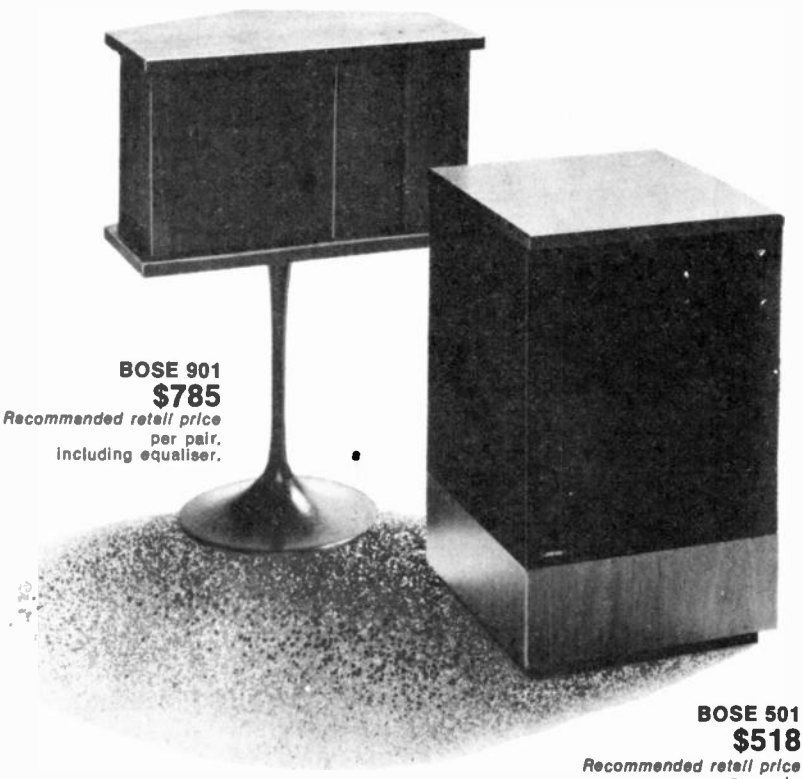

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RECORDINGS... POP TRENDS

REVIEWER:
Michael Delaney.

"GRAHAM NASH – DAVID CROSBY" – Graham Nash & David Crosby. Kenney. Stereo. SD. 7220. – Southbound Train – Whole Cloth – Blacknotes – Strangers Room – Where Will I Be? – Page 43 – Frozen Smiles – Games – Girl To Be On My Mind – The Wall Song – Immigration Man.

Nash and Crosby have always seemed an improbable recording team due to the vast difference in priorities between their two styles. Nash is a compact singer/songwriter who leaves no loose ends with his work: form and immediacy being the strongest assets outside his lyrical optimism. His songs are neat and wholesome and altogether very nice – perching somewhere on the border that separates the cute from cornball schmuck. And – at the worst – he has difficulty trying to make it all sound memorable. His music depends a whole lot on sentiment about which he happens to know a good deal – churning it up and spitting it out like some great smarm machine. But the thing is that it never completely backfires and that's just about the sole criterion anyway.

Crosby – on the other hand – is a fine musician unconcerned with defining form and purpose as such. His music is contained within its vocal/instrumental imagery and not in the catchiness of each song judged through its immediate appeal. Nash is going to sell more records than Crosby but in comparison he's neither terribly adventurous nor unique: David can be startlingly individual and even brilliant whereas Graham just goes on making the best he can out of being a dichard romantic. Crosby works with tone and shade and mood and motion, forcing the least possible compromise whilst Nash constantly inhibits his own potential by maintaining simplistic form – verse/chorus/verse and so on up the charts. It's pretty bewildering when they both end up side-by-side on the one album – each strengthening his own identity in ricochet off the other.

As a progression from their first solo outings – "Songs For Beginners" by Nash and Crosby's "If I Could Only Remember My Name" – this combined effort leaves both artists at a distinct advantage. Nash has put a bit more spunk into his writing and the results come over with a whole lot more vitality – the tunes are more substantial and magnetic; his presentation more direct and his performance has greater impact than most anything he's previously recorded. Whilst there's nothing quite as poignant as "Simple Man" or as disarming as "Military Madness" he's managed to avoid the likes of "Be Yourself" – the prime example of why "Songs For Beginners" wasn't what "Simple Man" was. "Southbound Train" and "Immigration Man" are his two best cuts mainly because he's found a way to get the most out of the saccharine. All told it's a matter of perspective: the themes are essentially the same as on any Nash epic apart from the fact that they've not been engulfed with the idea of sounding sweet. He's much improved.

There's not overly much to say about Crosby because his entire approach has always been self-sufficient. "If I Could Only Remember My Name" was the basic statement from which all forthcoming material would take shape. He hasn't so much improved as he has become a little more detailed: his music has grown and sprouted new shoots – the buds of which become increasingly more noticeable with each new track. If anything he's not quite as obscure as he has been in the past particularly with reference to the first solo album. "Whole Cloth" and "Where Will I Be?" paint fewer instrumental pictures than we've been accustomed, shifting the emphasis back onto the vocal passages. "Games" follows in much the same way as does "The Wall Song" – the latter being one of the rare Crosby songs to take a predictable verse/chorus frame.

Despite all this there's still that feeling of enormous motion in his style – a breathless fluidity; a pervading calm held in flight and almost suspended. Crosby can be incredibly original whilst Nash can only ever hope to be unbelievably cute. Don't take that as a put down because it's just the way things are. This is an album to buy so long as you don't expect to hear a unit duo rattling across a bunch of pretty tunes co-penned. Both retain their personalities intact; each employs the other only as an extension of his own ideas. – M.D.

"EXILE ON MAIN STREET" – The Rolling Stones. W.E.A. Stereo. COC. 2-2900. Rocks Off – Tumbling Dice – Torn & Frayed – Rip This Joint – Hip Shake – Happy – Turd On The Run – Casino Boogie – Sweet Virginia – Black Angel – Let It Loose – Just Wanna See His Face – Loving Cup – Shine A Light – All Down The Line.

"Exile On Main Street" is one of the best albums yet released by the Stones simply because it's more consistent, magnetic and extroverted than anything issued since the early days back around "12 X 5". It has that missing element running through each of the tracks – an added insight in feel that hasn't been with them fully for a number of years. They're probably still experimenting as much as ever – it's just that they've found renewed spirit to play out muscle and not their mind. And that's essentially what made them in the first place with songs like "Not Fade Away".

The Stones have this incredible ability to rock – an ability that they've never seemed totally satisfied with. Right the way through they've avoided hitting the music head on, preferring to add and subtract ideas rather than just bash out good honest noise. This may have been fine for the image but it's done little more than confuse both their style and approach. And that's the thing they've needed to rectify because the music hasn't been as effective.

"Exile On Main Street" is somewhat of a return to basics. It's probably the most stimulating and viable record they've cut since "Now" purely because it fulfils their promise as a rock 'n' roll band. And apart from everything else – it stands as the most rewarding album issued since "Let It Bleed" because its song content isn't affected and transitory: The music doesn't reflect change within itself – an aspect that has partically undermined each disc as far back as "Aftermath".

It's taken the Stones well over five years to fully rid themselves of the ambiguity and nagging abstraction in style that came to the fore with "Between The Buttons"/"Their Satanic Majesties' Request" – a period that barely justified its motives. "Beggars Banquet" was a comparatively successful attempt at American country-blues making its two feature cuts in "Sympathy For The Devil" and "Street Fighting Man" appear incongruous. Then there was "Let It Bleed" and "Sticky Fingers" – two fine discs both of which had energy complexes due to their lack in clarity. All three had the power held in slight reserve – a failure on the part of the band to respond directly to their own material. The Stones would create a series of moods and then fail to reinforce them by not allowing each enough room to take hold. And that's not the way to make an album work for itself.

There was "Brown Sugar", "Bitch" and "Midnight Rambler". Grand Funk did a more destructive version of "Gimme Shelter" – not due to them being a better band – but because they heaved it up with a brittle edge missing from the original. "Live With Me" was another song that didn't

POP TRENDS

come across the way it was meant. The Stones had to do a 'live' re-take on "Get Yer Ya-Ya's Out" before it worked up the guts to really reach the masses.

The band had been skimping on punch – directing its fire into the music and not out to the audience. There was no continuity between the songs and no set level in approach to help bind them together. The Stones just weren't exercising their potential as a sweat machine.

"Exile On Main Street" is the straight rock 'n' roll album that the group has always been threatening to record. It has an immediacy that contrasts all previous work right back to those first three discs circa '63-'65. The whole sound has progressed full circle retracing its origin and regaining in nature an equal to the loss in novelty. Jagger/Richards have started to write mostly in the riff-rhythm vein and the band is attacking each song 'en masse' with neither time nor space for unwarranted soloing. It comes off better this way because the Stones have seldom felt at ease when forced to play outside the melody frame – an approach that they've never quite known how to handle despite its success.

One of the most satisfying things about this double-set is its unity. There's a colour and determination here that recalls the strength of a band itching to get back on the road. The Stones have spent the last year rounding out their music in an effort to smooth off the edges – to make it less irregular. They've finally had the chance to absorb their influences and get back to even keel – making each song stand on its own merits.

The Stones have gone home to boogie with all the pressure jammed tight behind the rhythms. They've recaptured their old anger and have left it to seek its own direction. This – in turn – has given the songs an uninterrupted flow in performance far surpassing any standard their older material may have achieved. There's an added grit and fluency – a greater sense of style. Everything has been made less complex: the arrangements are more purposeful and energetic; the songs are looser and their treatment less schizoid. Somewhere in between "Sticky Fingers" and the recording of this current batch Jagger & Co realized that they'd lost perspective as a group – the music was only hinting at its true impact. The Stones hadn't been weaving their spell.

"Exile On Main Street" can be viewed as the culmination of the ideas worked on since "Beggars Banquet" in that it's more indicative of the band having come to terms with inner change. The music has its own identity and can now act as a motivating force in its own right – the essential difference between "Sticky Fingers" as an album compared with "Brown Sugar" as just one song. The Stones are sounding more dynamic and aware of what they're actually trying to lay down. And after four years – that comes as some releif.

There's a whole mess of good songs on this double-set – most of them great and some verging pretty close to being classics. There's "Rocks Off", "Rip This Joint" and "All Down The Line" – three road tunes. There's "Sweet Virginia" and "Black Angel" – country-gospel stuff rivalling "Wild Horses" in their simple beauty. There's "Turd On The Run", "Stop Breaking Down" and "Hip Shake" – traditional blues the way it used to be in things like "Honest I Do". But they're funkier – more compact and vicious. They all have one major aspect in common and that's a sense of unfailing movement. More than anything else "Exile On Main Street" M-O-V-E-S – a feeling that makes it just a little more than musical.

If you ever wanted proof that the Stones are the best rock 'n' roll band yet to tread the face of this earth then go get a copy of this new album. They've rarely sounded so fine. Taylor and Richards have cleaved together to rip through some of the nicest lead guitar you're going to hear – it's nice because it's played with style. They act out Yin to Yang and exchange cross-fire within the rhythm giving each song greater bearing on itself.

The Stones have always had one or two masterpieces on each album – songs like "Sympathy For The Devil", "Midnight Rambler" and "Brown Sugar". But "Exile On Main Street" has got to be their highest point as a collection marking a near total return to rock 'n' roll – something that they should never have strayed from in the first place. This is the Rolling Stones summoning up all their resources in one solid lump. The wait has been excruciating. – M.D.

"ROCK 'N' ROLL REFUGEE" – John J. Francis. Kinney. Stereo. WS. 2007. – Sunrise – Train – A Dream... Anytime – Talking Down Lane – Yesterday We Were – 42 Hampstead Avenue – Just A Dreamer – Horse & Carriage – You Run & Run – It Doesn't Matter... Yet – It's Not Easy (So Far Away) – Why Do You Think I'm Leaving – Fat Al's Big Chance.

John J. Frances isn't bad – fairly interesting in fact. He has a strong voice and his songs are warm and gentle. Most of them aren't terribly good but – at least – they're warm and gentle. The trouble with this album is that he can't do his own music justice: he can't play great guitar and his style is a stereo-type. You could be kind and call it eclectic in its influences but John J. is just a little too eclectic. And sometimes it's confusing. When he gets into a jazz feel he seems to be doing fine – as on "Hampstead Avenue". Othertimes, however, his songs fall short because he doesn't vary their treatment, and then it's a waste.

The most likeable aspect about "Rock 'n' Roll Refugee" is the way the backings don't intrude on his emotions. In this it's remarkably pure. Francis keeps everything simple so as to give more impact to the melodies. And his melodies need impact – something that is only partially achieved. Things like "A Dream... Anytime" and "Yesterday We Were" are quite beautiful mainly because he lets them loose to flow: "It's Not Easy (So Far Away)" is the most beautiful due to the way it just floats – drifting and shimmering and even soaring. It makes all the rest pall in comparison.

This is a pretty good debut release – better than "Hannagan" and infinitely more refined than Hans Poulsen. It's not a gem. Russell Morris is about the only Australian soloist to have done anything really exceptional to date. There's a lot to John J. Francis and I hope he has enough drive to carry it through. – M.D.

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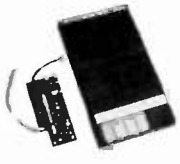

CASSETTE RECORDER KIT

Latest Model — push-button controls. Battery-operated with remote on-off switch on microphone. Mechanical and electronic sections pre-assembled and tested. Fully imported. Price $29.95. Post $1.00.

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Comprising transformer, mounting plate, silicon bridge rectifier and smoothing capacitor plus screws, nuts, etc.

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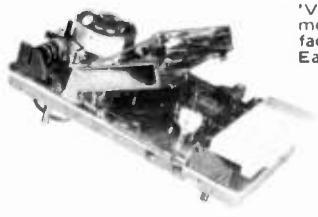
STEREO CASSETTE DECK



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AUSTRALIA'S BIGGEST ELECTRONICS DISCOUNTERS

RECORDINGS... JAZZ

REVIEWER: John Clare.

EARL HINES – 57 Varieties. CBS International Mono 63 364. Caution Blues, A Monday Date, 57 Varieties, I Ain't Got Nobody, Love Me Tonight (two takes), Down Among The Sheltering Palms (two takes). With rhythm section: I Hadn't Anything 'Till You, You Can Depend On Me, 'Deed I Do, These Foolish Things, Rosetta, Diane.

Anyone who has seen Earl Hines in concert – and Australian audiences were so privileged recently – will have no doubt that he is one of the great living masters of the piano. A real jazz technique. In fact he even stands up to strike certain notes with the exactness of attack and striking direction required, just as does Artur Rubinstein.

I have rarely heard a piano come so brilliantly alive as did the one which Hines played in Sydney. The great chiming sound which he elicited so effortlessly from the instrument made the excellent Australian pianist Chris Tapperrel who followed him sound as though he was playing with the soft pedal on. Watching Hines's hands, each as agile as the other, running and striking as though directed by independant intelligences, was a completely magic experience.

Yet, obviously, technique, was only the beginning. In one selection he took a break which swung so hard that I actually experienced that slight uneasiness you get when you have propelled a swing up to the point where it seems about to whip over the cross bar.

Everything is here on this famous reissue recording (and remember that it's CBS INTERNATIONAL so not all the stores will have it) except the full magnitude of Earl's piano sound. The unaccompanied tracks were recorded in 1928 and 1932, and are perfectly good – just lacking in presence. The others were recorded, indifferently for the time, in 1950. Hines does not need bass and drums, but as they are there (J.C. Heard and Al McKibbon) one would have liked a little more clarity and crispness.

In some of the more complex breaks on the earlier tracks Hines actually loses time slightly, which just goes to show even the greatest have got to work at it. It is an apparent contradiction to speak of breaks on an unaccompanied track, but that is just what it sounds like when Hines's rhythm section (his left hand) stops and both hands begin to chase each other about in four bars of suspended time. These recordings must have scared every pianist nearly to death when they appeared, and they will startle anyone who listens to them today.

The more recent tracks with the rythm section bring out the occasional similarity to both Errol Garner and Oscar Peterson in Hines's playing.

McKibbon and Heard swing along in relaxed fashion, and it's a good easy bouncing session. Hines has really got his time down on "These Foolish Things", as he has for the past forty years or so.

An essential record for any comprehensive jazz collection. - J.C.

LOUIS ARMSTRONG – Louis Armstrong July 4, 1900/July 6, 1971. RCA Mono VPM – 6044 Double Album includes You'll Wish You'd Never Been Born, Back O'Town Blues, Blues In The South, I Want A Little Girl, Some Day You'll Be Sorry, Ain't Misbehavin', Pennies From Heaven etc.

All in all it must be said that there are better Armstrong records available on Swaggie, CBS and CBS International than in this collection which starts in 1932 and ends in 1956, taking in rather too many of Armstrong's less memorable pop efforts in front of various big bands, string augmented orchestras and heavenly choirs. However, there are about nine gems recorded by all star groups which included people like Jack Teagarden, Vic Dickenson, Bobby Hacket, Barnye Bigard, Sid Catlett and Zutty Singleton, recorded in the late Forties.

My favorite is Back O' Town Blues on which Jack Teagarden plays a solo you would think nobody could follow, until Louis plays so much blues on the trumpet that you wonder why it does not melt. You'll also hear Bobby Hacket's trumpet obligato behind Louis's wonderful vocal.

Louis was one of the most prolifically recorded artists of all time, and there are tracks here which one had forgotten about. Louis does something on even the corniest things to make it worthwhile, but it you've already got a lot of his swing band stuff, you'll probably hesitate before adding this to your collection just because of the superior all star performances. – J.C.

JACQUES COURSIL – Black Suite. America Stereo 30 AM 6111. Coursil, trumpet, Arthur Jones, alto sax; Burton Greene, piano; Beb Guerin, bass; Anthony Braxton, bass clarient, soprano sax; Claude Delcloo, drums.

There is still a great deal of new music to be created in the areas opened up by the contemporary jazz pioneers. Too many of the newer jazzmen seem to have got themselves into ruts already, to judge from some of the recent records I have heard. Archie Shepp, for instance, who is capable of writing brilliant themes and arranging them in such a way that free solos can grow naturally from the written framework, seems content much of the time to rely on short riffs and long improvisations of greatly varying quality. This recording too, by Martinique trumpeter Coursil, reflects the malaise.

The Black Suite, by Coursil, consists of some minimal writing at beginning and end, and a lot of restrained, pleasant, but generally unmemorable improvisation. Coursil gets a good basic sound from the trumpet, but his playing lacks direction. Much of the time his solos sound like prolonged cadenzas. The presence of the talented Claude Delcloo is barely felt at all, and nobody else distinguishes himself, with the notable exception of Anthony Braxton.

Braxton's bass clarinet emerges from the background with about a third of side one to go. That third of a side almost makes the record a good buy. Braxton is undoubtedly one of the three or four most talented of the younger jazz men. Usually he is heard on alto, but he shows here that he's definitely got something to say on bass clarinet. The range of sounds he produces is quite uncanny, and he is ordering all of his

JAZZ

effects musically, often with great emotional force.

On side two, nothing happens at all. If you can get a free listen to the Braxton solo your time will have been well spent. I don't really think that the record as a whole is worth spending money on. J.C.

BILLY MAY – Sorta May. Creative World Duophonic 1051. Thou Swell, Blues In The Night, Chicago, All You Want, You Go To My Head, Soon, In A Persian Market, You're The Top, The Donkey Serenade, Deep Purple, They Didn't Believe Me.

Every now and then we give notice of one of the Stan Kenton Albums available through Stan's Creative World Inc. However, Stan is not just pushing himself. If you wrote to the above address I'm sure they'd send you a list of recordings which would include stuff by Johnny Richards, Bill Holman, Bill Russo and the whole gang who were associated with Kenton.

Billy May was never to my knowledge associated with Stan, but it is appropriate that Stan should be making some of his best work available again. They had this in common, that they sometimes seemed to be trying to push the world's best studio musicians to the limits of their virtuosity. Although operating generally in a more commercial and light hearted idiom than Stan and his boys, Billy May probably has more natural musical ability than most of them. I am pretty sure it was May who was largely responsible for the reed voicings which were the most interesting part of the Glen Miller band – I could be wrong, but I know he did write for the Sinatra Conducts album which has remained almost an arranger's manual to this day.

May's writing is nearly always flippant or whimsical in tone. Climaxes are just that degree over done: the trumpets go whack! spleeeeeyee-ee-ee, and it's exciting but also very funny; and they are often followed by a cheeky flute, or even a triangle. His most consistent trademark is the full but airy-sounding sax section which executes some hilariously drawn out slures – displaying just incidentally an extraordinary degree of togetherness and control.

This is basically a dance band – today it even sounds a bit like superior Muzak – but it remains splendidly dynamic and witty. There is the key to much of this music. It is not deeply sensuous or groovy – though sometimes slyly so – but dynamic and exhilarating. – J.C.

THE BOSS OF THE BLUES – Joe Turner sings Kansas City Jazz, Atlantic High Fidelity 1234 STEREO. Personnel of backing group: Pete Johnson (piano); Freddie Green (guitar); Cliff Lefma (drums); Walter Page (bass); Joe Newman, Jimmy Nottingham (trumpets); Pete Brown (alto sax); Frank Wess, Seldon Powell (tenor saxes); Lawrence Brown (trombone). (Not all the front-line musicians play on every track.) Side 1. Cherry Red, Roll'Em Pete, I Want a Little Girl, Low Down Dog, Wee Baby Blues. Side 2. You're Driving Me Crazy, How Long Blues, Morning Glories, St Louis Blues, Piney Brown Blues.

Joe Turner is surely one of the finest living blues singers. At the age of 60 he is still churning out great jazz and probably the only contender in his age group and with a similar repertoire would be the venerable Jimmy Rushing (another Kansas City lad).

Although Turner is billed as a blues singer, all the numbers on this record are not strictly blues. Blues, are not, as many people think, a slow melancholy form of music. The term "the blues" denotes a special chordal pattern of 8, 12 or 16 bars (usually 12) as opposed to the usual popular song form of 32 bars.

The blues can be any tempo at all but the lyrics always tell a story be it sad or gay, sweet or harsh.

And Joe Turner is a story teller and has been since he began singing the blues in bars in his hometown, Kansas City at the age of 14.

This record was made in New York with small-star backing unit and simple arrangements which allow Turner to be himself – to sing clearly and forcibly.

Perhaps the number most associated with Turner is "Wee Baby Blues" a typical Kansas City shout which he previously recorded with the great pianist Art Tatum. "I Want a Little Girl" has him singing in his gravelly tones a pop song of another era and making this unpretentious piece sound like pretty good jazz.

The other pop piece (circa 1928) is "You're Driving Me Crazy" in which the band backs him by playing the riff from "Moton Swing" a standard big band swing era arrangement which utilised the chords of the song.

However, good as he is with lightweight songs such as these, Joe's real forte is blues and more blues.

On "Roll 'Em Pete", "Low Down Dog", "St Louis" and "Piney Brown Blues" he is at his peak – his voice runs the gamut from heartbreaking sadness to vital joyousness from a whisper to a hoarse shout.

The accompanying musicians could not have been better chosen. Pianist Pete Johnson has been associated with Turner from his earliest days and is *the* ideal backstop.

Pete Brown, one of the all-time greats on alto sax, excells himself – his gutzy, stompy swinging style makes him one of the four best altoists ever (together with Hodges, Carter and Willie Smith).

Frank Wess (tenor) Freddie Green (guitar) and Walter Page (bass) all came out of the Count Basie band and that should say enough. Lawrence Brown (trombone) was for years with Duke Ellington, so he's no slouch either.

Although Jimmy Nottingham (trumpet), Seldon Powell (tenor) and Joe Newman (trumpet) are not as well-known as some of the other musicians they are fine articulate players who suit this type of music admirably.

For lovers of the blues, of Kansas City style jazz, of Joe Turner and Pete Brown, this is a must. – M. A.

BOOK REVIEWS

REVIEWER: Brian Chapman

BASIC ELECTRON DEVICES by E. George Griffith. Published by Holt, Rinehart and Winston 1971. Soft covers, 212 pages 9" x 6". Review copy supplied by Holt, Rinehart and Winston. Australian price $4.40.

This is the basic volume of Rinehart Press Electronic Technology series and knowledge of the material contained is a prerequisite for all the later volumes.

The book is a "labour of love" of its author who completed this work knowing that he had only a short time to live and could not financially benefit from its publication. Primarily his aim was to provide assistance to young students, and this aim shines through the text.

The opening section inevitably deals with the physics of devices. It is unfortunate that this theory, which is so essential to thorough understanding of later topics, is almost always presented in a dry and uninteresting manner. But Mr Griffith has made quite a creditable effort in alleviating the tedium of this subject.

Solid state devices are introduced by means of sections on the PN junction, the Junction Transistor and Electron Emission and Acceleration, and then the last four sections examine valve theory in considerable detail.

Again, as is the practice with all the volumes in the Electronics Technology Series, each chapter includes adequate diagrams and examples and is followed by selected problems and questions.

The text is clear and concise, with all the relevant formulae provided where applicable. Transistor and valve theory each consume about 50% of the book.

All books of this excellent series are recommended as companion texts for technical college courses in electronics. – B.C.

(Turn to page 118)

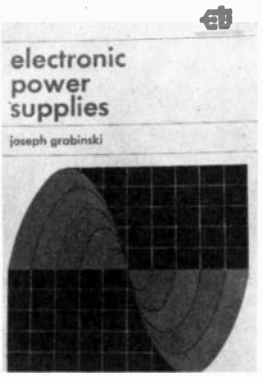
BOOK REVIEWS

TAPE QUESTIONS – TAPE ANSWERS Compiled and answered by Heinz Ritter. Published by Josef-Keller-Vereag Starnberg, Germany. Soft covers, 126 pages 8¼ x 5¾. Review copy supplied by Maurice Chapman Pty. Ltd. Australian price $1.00.

Heinz Ritter was head of the BASF tape marketing section in Germany at the time this book was written, and is now head of sales in educational technology.

Tape recorder useage, whether it be reel-to-reel, cartridge or cassette, has increased dramatically in the last few years. Tape recording is no longer a pastime reserved for the dyed-in-the-wool audio expert. Instead recorders, particularly cassette, are beginning to rival hi-fi record players for the reproduction of canned music.

There has been an obvious need for a book setting out in an easily understood manner, the basic principles of domestic tape recording technique. The present volume adequately fills this need at a more than reasonable price. B.C.



ELECTRONIC POWER SUPPLIES by Joseph Grabinski. Published by Holt, Rinehart and Winston 1969. Soft covers, 223 pages 9" x 6". Review copy supplied by Holt, Rinehart and Winston. Australian price $4.40.

This book is a further volume of the publisher's Electronics Technology series designed for use in technical colleges and institutes.

The object of the book is to give a thorough understanding of power supply circuits and the waveforms found in these circuits. A knowledge of dc and ac network theorems and a basic understanding of transistor and valve circuitry are prerequisites.

Section one contains an introduction to basic rectifier circuitry, an examination of half-wave and full-wave circuitry under different load combinations of R,L and C plus a treatment of voltage doublers and triplers and practical rectifier systems.

Section two deals extensively with polyphase rectifiers and this is followed by a section on magnetic amplifiers.

The last three sections give details of components and circuitry used in conventional regulator circuits. Included are details of the use of thyratrons, SCR's, Zeners in series and shunt regulator circuits.

The text is clearly written, in a no-nonsense format, and has adequate diagrams and examples to give the student every assistance in assimulating the data.

Each chapter is followed by a selection of problems designed to confirm and extend knowledge of the chapter content. Answers to odd-numbered problems are given in the rear of the book. Additionally, a series of questions are included at the end of each chapter which may be used as a rapid self test of comprehension.

At the modest price, this book is excellent value indeed and is well recommended for students of electronics. – B.C.

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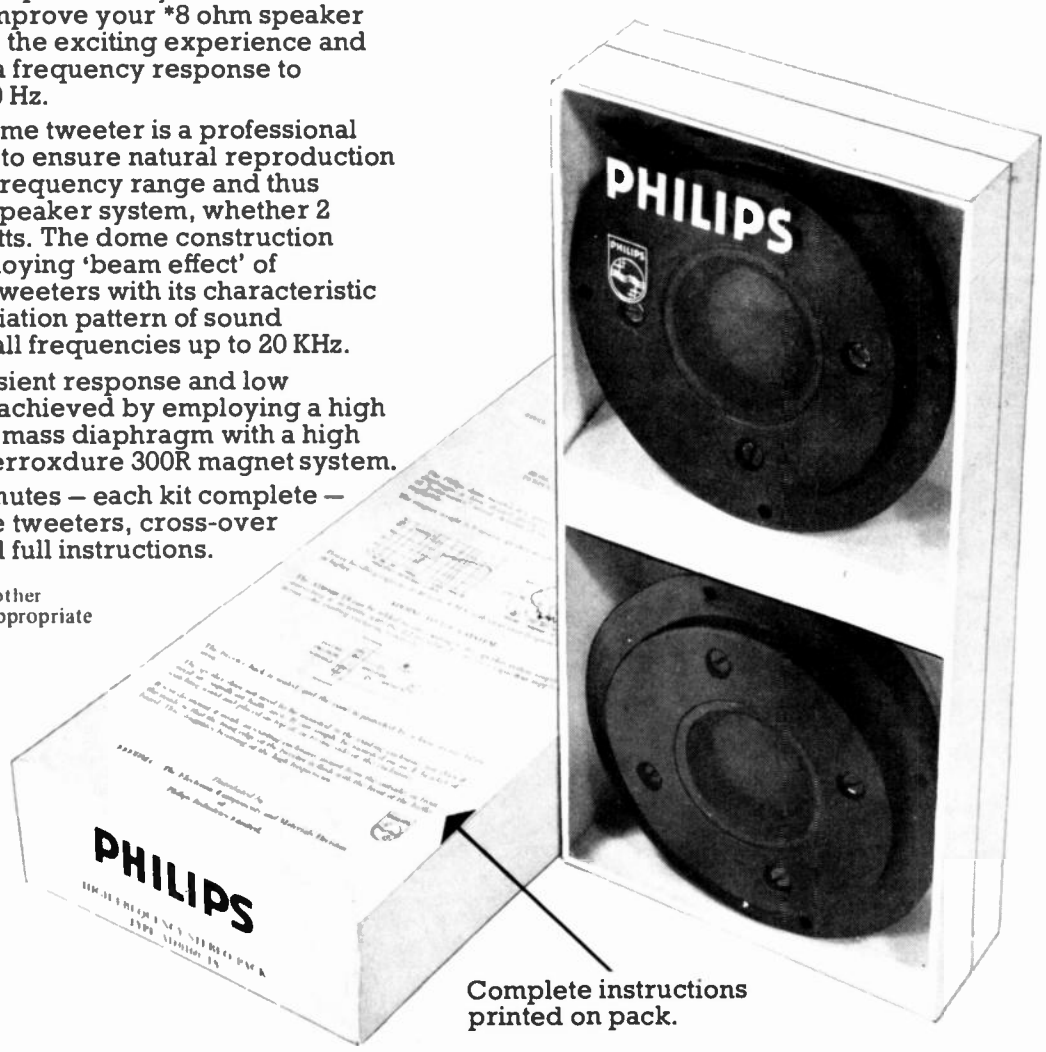

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INPUT GATE

LETTERS FROM OUR READERS

CASSETTE RECORDERS

A couple of hi-fi dealers have told me that good cassette systems now have a performance equal to top quality record systems. Do you agree with this?

F.S. Bathurst, NSW.

** Almost. Certainly the latest cassette recorders incorporating the Dolby noise reduction system and using top quality tape have an excellent performance. In fact they are at least as good as the vast majority of record systems. Nevertheless they do not quite equal the really top quality record systems — such as say a Thorens deck and Shure or Stanton cartridge.*

However the manufacturers of cassette decks improve their performance almost daily and these comments may be out of date before they are even printed! Frankly if the cassette format appeals to you we suggest you go ahead and buy one.

TACHOS WITH CDI SYSTEMS

Is it possible to operate an electronic tachometer from a CDI ignition system?

K.L. Noosa, Qld.

** Generally it is not — in fact many electronic tachometers will affect the operation of CDI systems. However we were aware of this when we designed the ETI tachometer (ETI 302, July 1971) and this unit may be used with all existing CDI systems.*

LEG PULL?

With reference to the news item 'Large Scale Integration' on page 13 of the July issue of Electronics Today International, whose leg is being pulled, yours or the readers?

S.S. Hemel Hempstead, UK.

Have you noticed the news item has been separated from the rest of the copy by two heavy black lines? Incidentally we hear that the company have coined a new slogan for their product, 'Klux' — the ultimate detergent. They now claim that it washes blacks whiter than white.

BOOB BOO BOO

I agree with S.G's opinion (Input Gate August '72) concerning the excellent technical quality of your magazine but I feel that his opinion of the feminine qualities of said advertisement to be utter hogwash. Such people have a narrow-minded view. The advertisers are to be commended for their presentation.

ZERO TRACKING ERROR

The pickup arm you show in the article Zero Tracking Erro (June '72) does not have zero tracking error. Indeed, if the head remains parallel to the fixed portion at the rear, then obviously it does not remain parallel to the groove at all points.

This arm is evidently operated as a parallelogram, i.e. with the twin booms of similar length. The secret of the Garrard Zero —100, and before that, the BJ arm, is the use of twin booms of unequal length.

The present writer had this idea in 1949 and was foolish enough not to pursue it. Frustrated at the appearance of the BJ, he is completely baffled at the claim made by Garrard that they are the first!

If Jim Davis will kindly use an alignment protractor on his pick up arm, he will find errors of up to five degrees in the tracking.

I.C.

ZERO —100 REVIEW

How do you explain the fact that every electronics and hi-fi magazine in the world have given the Zero —100 turntable a rave review whilst yours was somewhat less than enthusiastic.

T.S. Newport NSW.

** Let's take your points one at a time. Firstly it is not true that all magazines except ours gave rave reviews. For example writing in Hi-Fi Sound (August '71) John Wright says 'We feel to go to all this trouble simply to avoid a few degrees tracking error towards the outside of the disc is merely a rage over a lost penny'. Many other equally authoritative reviewers have made similar comments.*

Secondly, price must be taken into account when reviewing any item of equipment. In England this unit costs £55 — here it is quoted (by the distributors) at $268. It is in competition with many other excellent units at similar and lower prices. In fairness to other manufacturers and our readers we must bear this in mind in our final assessment.

Thirdly, as we were aware of the unit's overseas reputation we took the precaution of testing two Zero —100 units. Both had substantially similar performance. We stand by our review.

Rapar PUBLIC ADDRESS AMPLIFIERS

SPECIFICATIONS	Rapar TPA31	Rapar TPA40
Power Output:	30W Nominal, 20WRMS on 8 ohm load.	40W Nominal 28WRMS on 8 ohm load.
Input Sensitivity:	1.2mV on Mike 1&2 200mV on Aux. 1&2	1.2mV on Mike 1&2 200mV on Aux. 1&2
Frequency Response:	100-20000 Hz	100-20000 Hz
Tone Controls:	−9dB @ 5k Hz −19dB @ 10k Hz	−9dB @ 5k Hz −19dB @ 10k Hz
Power Source:	12V DC or 240V AC	12V DC or 240V AC
Size:	245mm x 120mm x 195 mmD.	245mm x 120mm x 195 mmD.
Price:	*$71.30 Tax Included	*$80.50 Tax Included

Rapar TPA80

Power Output: 50W RMS 80W on Program.

Output Impedance: 4, 8, 16 60 and 200 ohms.

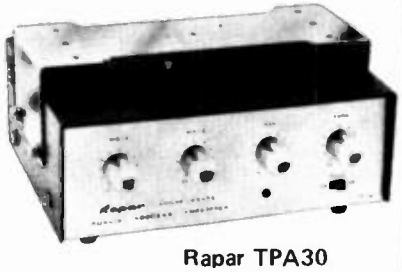
Frequency Response: 50-20000 Hz.

Inputs & Sensitivity: Mike 1&2 2mV, Aux/Phono 300mV.

Hum & Noise: Mike 1&2 > 50dB, Aux/Phono > 60dB.

Size: 230mm. x 145mm. x 340mm.

Price: *$112.70 Tax Included



Rapar TPA30

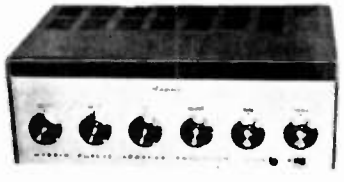
Solid State 20W Output

Impedances: 4,8 and 15 ohms. Also 25V & 70V line System.

Inputs and Sensitivity: Mic. 1 — 2mV at 600 ohm., Mic. 2 — 2mV at 50K ohm., Aux. — 200mV. 240V AC or 12V DC Operation

Size: 9½" x 4" x 7½"

Price: *$57.50 Tax Included



Rapar PA539N

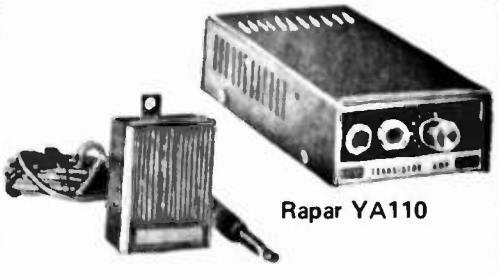
Power Output: 50W

Output Impedance: 8, 16, 250 ohms. Also 100 Volt line.

Inputs & Sensitivity: Mic 1&2 5mV/50K ohm., Aux. 300mV/500K ohm. 240 V Operation

Size: 320mm. x 140mm. x 250mm.

Price: *$94.30 Tax Included



Rapar YA110

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12V DC Operation

Compact Size 6"L x 3¼"W x 1½"H.

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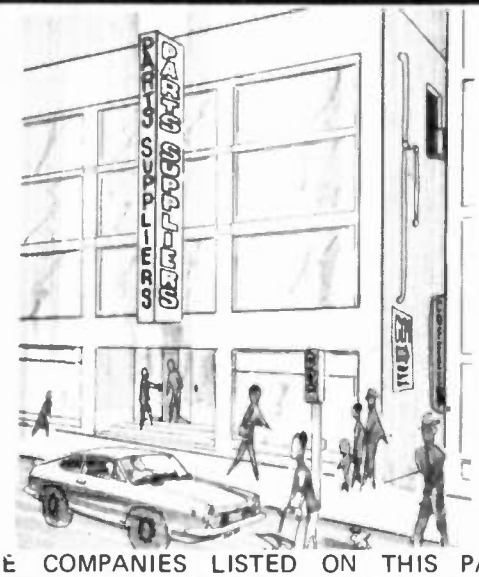

THE COMPANIES LISTED ON THIS PAGE STOCK KITS AND/OR PARTS FOR ETI PROJECTS. THEY DO THEIR BEST TO HAVE ALL PARTS AVAILABLE AS SOON AS POSSIBLE AFTER PUBLICATION.
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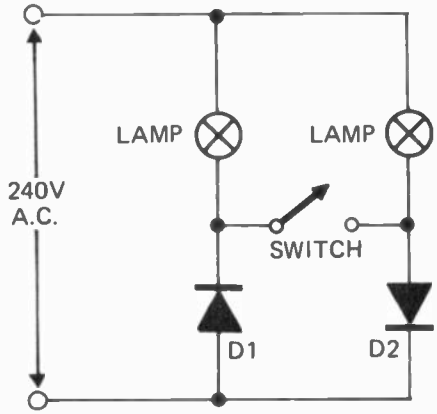
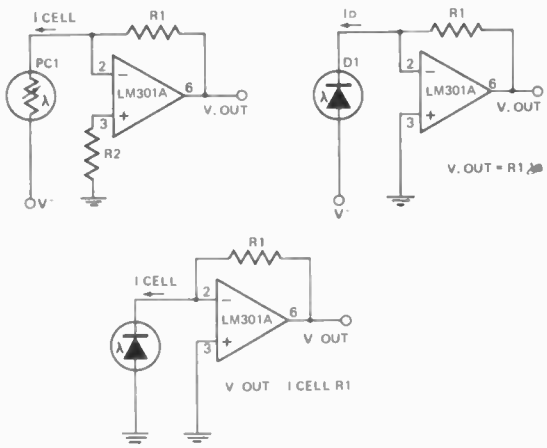
TECH-TIPS

FLOODLAMP POWER CONTROL



When setting up photographic floodlamps it is sometimes desirable to operate the lamps at lower power levels until actually ready to take the photograph. The circuit shown allows the lamps to operate on half cycle power when the switch is open, and full power, when the switch is closed. The diodes D1 and D2 should have a 400 volt PIV rating at 5 amps.

USING OP-AMPS AS PHOTOCELL AMPLIFIERS



Amplifiers for photoconductive, photodiode and photovoltaic cells are shown in Figures 1, 2 and 3 respectively.

All photogenerators display some voltage dependence on both speed and linearity. It is obvious that the current through a photoconductive cell will not display strict proportionality to incident light if the cell terminal voltage is allowed to vary with cell conductance. Somewhat less obvious is the fact that photodiode leakage and photovoltaic cell internal losses are also functions of terminal voltage. The current-to-voltage converter neatly side-steps gross linearity problems by fixing a constant terminal voltage, zero in the case of photovoltaic cells and a fixed bias voltage in the case of photo-conductors or photodiodes.

Photodetector speed is optimized by operating into a fixed low load impedance. Currently available photovoltaic detectors show response times in the microsecond range at zero load impedance and photoconductors, even though slow, are materially faster at low load resistances.

The feedback resistance, R1, is dependent on cell sensitivity and should be chosen for either maximum dynamic range or for a desired scale factor and should be chosen to minimize bias current error over the operating range.

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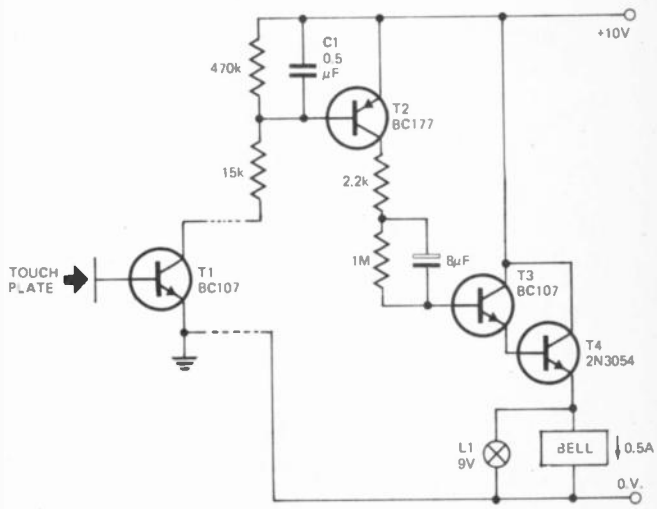
TECH-TIPS

TOUCH CONTROLLED DOORBELL



In the circuit shown, hum is induced into the touch plate when touched with a finger. This hum signal is rectified in envelope detector/amplifier T1 and the resultant dc current amplified by T2, T3 and T4.

Decoupling is provided by C1, and C2 limits the length of doorbell signal to three seconds. The recovery time between signals is five seconds. The lamp L1 may be used to verify the signal, to the caller, if required.

Submitted by: M.W. RICHTER Eindhoven Netherlands.

Bi-directional record and playback tape deck Model A-4070
● 4 Ferrite heads (6 head function) ● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● Triple motor mechanism ● Wow and flutter .06% at 7½ ips ● F/R 25 to 24,000 Hz at 7½ ips ● S/N ratio 58dB

Make music- not noise

You may not realise it, but until now, even the best tape decks allowed a degree of noise during recording and playback. This may have been all right for conventional tapes, since they were far from perfect.

But with the recent introduction of the low noise/high output tapes, it's no longer permissible.

Which brings us to a new generation of decks by TEAC. And TEAC calls them Superior Sound/Low Noise decks: decks designed to get the most out of the low noise tapes as well as the conventional types.

Five of these new generation decks are described here. If you'd like to know more, write to us and we'll send you further information (catalogue, dealer list and price list) on the unit(s) that interests you.

Stereo Tape Deck Model A-3300
● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● Triple motor mechanism ● Wow and flutter .06% at 7½ ips ● F/R 25 to 24,000 Hz ● S/N Ratio 55dB

Stereo Tape Deck Model A-1230
● 3 heads-4-head function ● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● Triple motor mechanism ● Wow and flutter .08% at 7½ ips ● F/R 30 to 22,000 Hz at 7½ ips ● S/N Ratio 55dB

Automatic Reverse Stereo Tape Deck Model A-1250
● 3 heads-4-head function ● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● Triple motor mechanism ● Wow and flutter .08% at 7½ ips ● F/R 30 to 22,000 Hz at 7½ ips ● S/N Ratio 55dB

Combination Head Stereo Tape Deck Model A-1030
● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● One motor mechanism ● Wow and flutter .05% at 7½ ips ● F/R 30 to 22,000 Hz at 7½ ips ● S/N Ratio 55dB ● Auto. Shut-off

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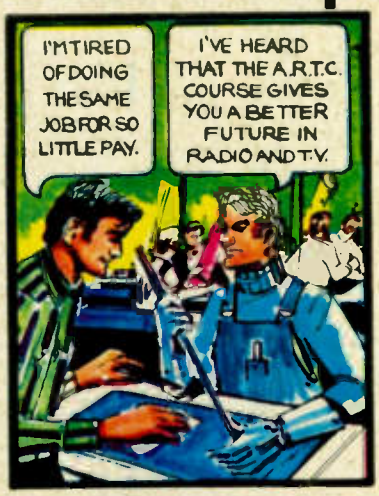

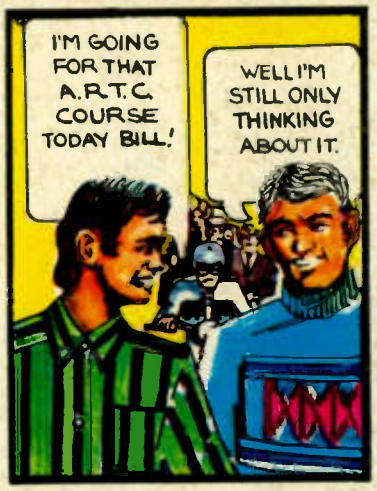

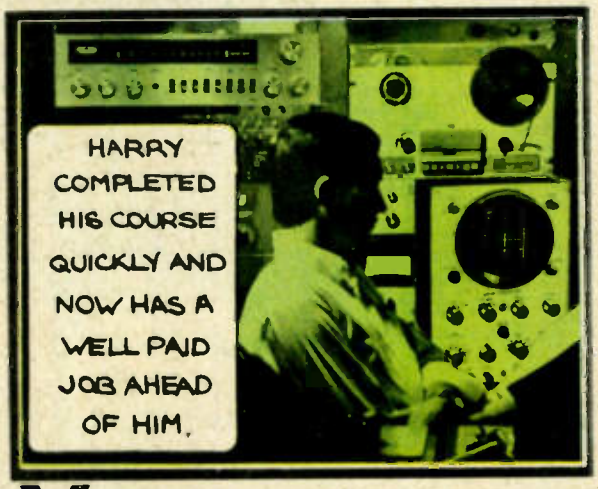

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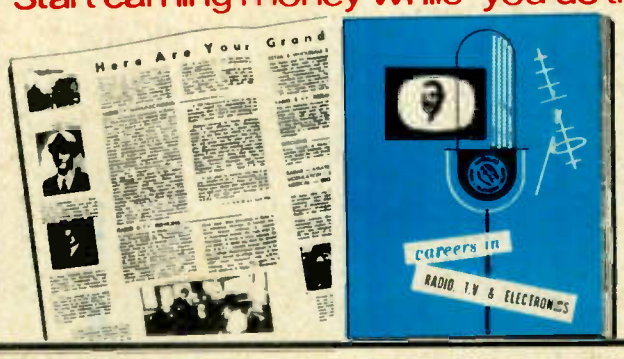

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