AUSTRALIA'S DYNAMIC MONTHLY MARCH 1972 50c

electronics TODAY

FIRST BIRTHDAY ISSUE

ELECTRONIC SPYING

PHOTOPRINT TIMER

IMPROVING TV SOUND

700-WATT AMPLIFIER

REVERB UNIT

ANTI-LOCK BRAKES

PRACTICAL GUIDE TO SCR'S

The compact convenience of Sony's stylish cassette tape decks is drawing more supporters every day

all hands on decks

Sony's TC-122 is the lowest priced stereo cassette deck yet it includes many advanced features like 4-track stereo and 2-track mono recording and playback, Sony-O-Matic — completely automatic recording volume control, solid state amplifier for low distortion, stereo level meter, all-silicon transistor circuitry, headphone jack and sleek design. About $144.00.

Sony's TC-127 introduces a new era of magnificent hi-fi tape cassette stereo sound at a modest price. Features include 4-track stereo and 2-track mono recording and playback, limiter circuit (on-off) to control input level for distortion free recording. Sliding-type recording volume controls for each channel with dual VU meters, tape sentinel lamp to indicate tape is running, 3-digit tape counter, headphone jack, attractive woodgrain cabinet. About $199.00.

Sony's TC-160 is an exceptionally sophisticated cassette stereo tape deck for unrivalled recording and playback. Features closed loop dual capstan drive system, first of its kind ever used in a stereo tape deck for perfect tape tension and to cut down wow and flutter to unusually low level. First hard and durable high performance heads adopted in a cassette deck. Limiter circuit to control input. Optimum manual control with separate right and left meters, sliding type volume controls. Tape selector for change from conventional tape to high performance. Easy loading. Low noise, low distortion solid state amplifier. De Luxe styling. About $281.00.

Distributed by

JACOBY KEMPTHORNE

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SONY

TO: Jacoby Kempthorne, 469-475 Kent Street, Sydney. N.S.W. 2000
Please send me, without obligation or cost, information on the Sony Models TC-122, TC-127 and TC-160.

NAME

ADDRESS

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electronics TODAY

MARCH Vol. 1 No. 12

main features

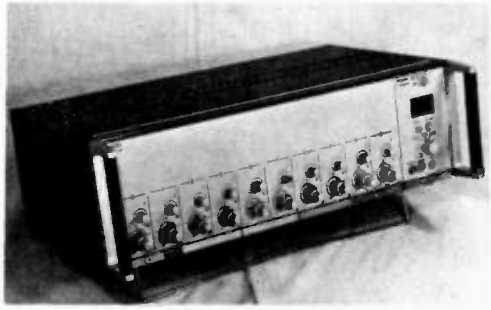
projects

product tests

reviews

news & information

Cover: Two back illuminated NIXIE tubes symbolise the 12th issue of Electronics Today. (See editorial page 5).



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feel the beat through your feet and hear the lyrics too

enjoy both with BASF LH-hifi recording tape

Sure, with any tape, you can turn the volume up until the floor shakes. The difference is the quality of the sound produced. When you are playing a BASF LH-hifi tape there is less distortion, more clarity and realism. The gradual narrowing of track widths and lowering of tape speed on domestic tape recorders place, above all, great demands on tape to head contact and magnetic uniformity. A natural consequence of this development appeared to be background noise which became more audible during sound reproduction. To counter this, BASF engineers have introduced low noise equalisations and eliminated the background noise, increased sensitivity and achieved a dramatic improvement in signal-to-noise ratio of as much as 8dB over other quality tapes. Now you can keep the swingers swinging with wall to wall sound while the neighbours enjoy the lyrics.

BASF LH-hifi tapes also available in Compact Cassettes.
Playing times:

C30	=	2	x	15	minutes	=	30	minutes.
C60	=	2	x	30	minutes	=	60	minutes.
C90	=	2	x	45	minutes	=	90	minutes.
C120	=	2	x	60	minutes	=	120	minutes.

BASF Compact Cassettes available everywhere in your choice of either "Trans," "Snap" or "Plastic Pack."

BASF HAS THE QUALITY—YOU MAKE THE MUSIC—BASF FOR ENDLESS PLEASURE

BASF

Australian Distributors:
Maurice Chapman & Company Pty. Ltd.,
276 Castlereagh St., Sydney. Phone: 61 9881.
146 Burwood Rd., Hawthorn, Vic. Phone: 81 0574.

BA1371C

we go international

Sometimes it seems like yesterday, sometimes like half-a-lifetime — but the plain chronological fact is that, with this issue, ELECTRONICS TODAY is one year old.

In that first year we have achieved most of the goals we'd set ourselves, and in some ways even exceeded our expectations. We have recruited a strong, vitally interested readership, plus equally strong (and still growing) advertising support, gained a reputation for being consistently first with the news, and — as we'd hoped to do — managed to reach a large and important audience untapped by other publications in this field: people who use — or need to use — electronics in their business, industry or profession, but who are not necessarily electronic engineers.

All of which has enabled us to take the next big step — which we had planned to take from the start — a little sooner than expected.

Beginning next month, a British edition of ELECTRONICS TODAY will go on sale throughout the United Kingdom, plus Holland and the Scandinavian countries.

From the very first issue, ELECTRONICS TODAY has presented electronics, in all its aspects, as an international topic. By its very nature electronics IS international — its equipment and techniques are not limited by national boundaries.

The new British edition demonstrates the validity of this approach.

Called ELECTRONICS TODAY INTERNATIONAL, the new magazine is a joint venture by a wholly-owned international subsidiary of our own company and Whitehall Press Ltd., of London.

Its format and basic editorial content will be similar to those which proved successful in Australia — but, naturally, it will also feature news and articles of special local interest, as well as its own local advertising.

Our Australian edition will continue unchanged — except that, from next month, it will also be called ELECTRONICS TODAY INTERNATIONAL.

British Editor of ETI is Paul Godden, previously with 'Electronics Weekly'. Collyn Rivers, Editor of the Australian edition since the inception of the magazine, becomes Editorial Director of both publications.

Since more responsibilities inevitably mean more work, we have added an Assistant Editor — Brian Chapman, a name well-known in Australian electronics.

Like all our editorial staff, Brian has an extensive background in electronic engineering. Previously Applications Engineering Manager of Natronics Pty. Ltd., he is a fully qualified illuminating engineer and a widely recognised authority in the field of lighting control. He has extensive experience in digital equipment and uhf communications systems, and has been closely associated with NASA's space missions at Woomera and Orroral Valley.

With our new international link-up, and the addition of Brian Chapman to our ranks, you can look forward to further improvements in the scope and value of ELECTRONICS TODAY INTERNATIONAL — to call it by its new name.

Collyn Rivers, Editor

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Barry Wilkinson

Production Manager:
Bob Izzard

Projects Adviser:
Kim Ryrie

Laboratory Technician:
Rob Giumelli

Review Editor:
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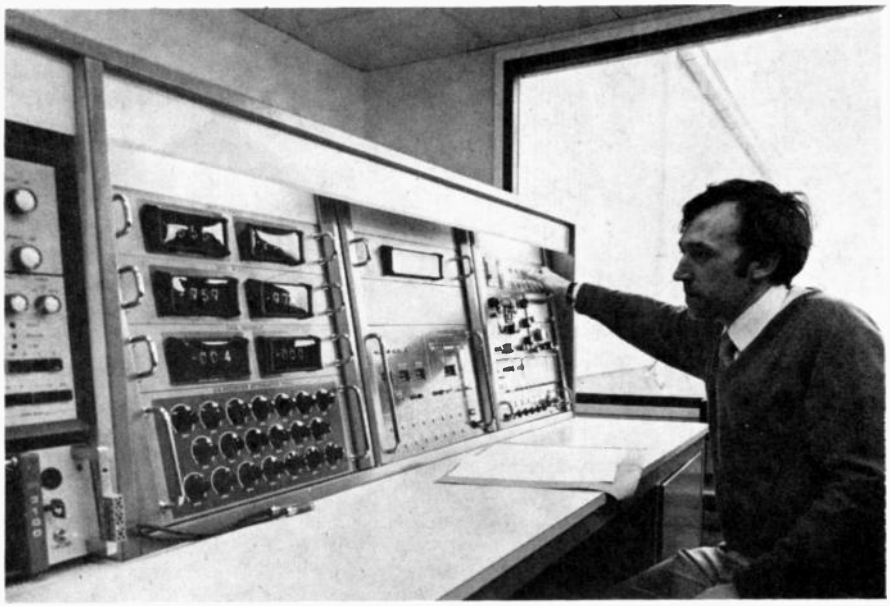
Assistant Editor

news digest

300 MPH HOVERTRAIN – PUBLIC SHOWING



Computerised control and data recording equipment that can handle information from up to 413 different sources will be used in the development of Britain's tracked hovertrain – during its period of full-scale development.

From this console, commands will be transmitted by radio to the hovertrain and radioed signals from the measuring instruments inside the vehicle will be received, recorded and analysed.

The 25-ton vehicle straddles the track and is supported approximately an inch above it by a system of fans employing the hovercraft principle. The linear motor consists of an aluminium strip set into the top of the track as the motor's "stator", and a complex set of electrical windings mounted inside the body shell. Power is picked up from a trackside rail.

The train made its first run over a mile of the track recently, watched by visiting experts and the press from several countries. It performed perfectly during the slow-speed run and is now expected to reach speeds of up to 90 mph during the next two months.

The hovertrain has been designed and constructed by Tracked Hovercraft Ltd., a company set up by Britain's National Research Development Council, and would be capable of providing a link between central London and the airport planned for Foulness, its passengers completing the journey in quiet pollution-free comfort in about 20 minutes.

FOUR CHANNEL DISCS

In the UK the EMI group have announced plans to release quadraphonic discs – using the CBS developed 'SQ Matrix' system – in April.

The company claims that the new discs will be fully compatible with existing stereo equipment.

EVR CASSETTES

The British EVR organization will be releasing their 1972 catalogue of Educational and training EVR cassettes in March. A list of their releases can be obtained, free of charge, from EVR Partnership, Vogue House, 1 Hanover St. London, W1, England.

BIAS – AUTOSELECTION

Cassette tape recorders that have been designed specifically for use with chromium dioxide tapes require special bias switching facilities.

At present this is done manually. However the latest BASF 'SM' chromium dioxide cassettes have a notch on the rear of the cassette (in addition to the tab now used to prevent erasure of recorded material) and, hope BASF – and Philips who are backing the system – future cassette players will have a switch mechanism actuated by this tab to bring in the necessary bias circuitry.

ELECTRONIC WATCHES

Motorola are marketing an electronic watch package consisting of one of their own complementary MOS circuits, an ultra-stable precision quartz crystal and a miniature motor.

The package is being developed by a special products group in the USA, and uses circuits from the Motorola Semiconductor Products Division, and crystals from the Consumer and Electronics Division.

Prices have not yet been disclosed, but Motorola say that they will quote immediately for individual orders.

IDEA LOOKING FOR A JOB

Many ideas that tantalize the scientist cannot be pursued within the normal framework of research. Often more pressing problems take priority, leaving individuals to ponder the practicality of ideas that are simple, yet teasing.

Over ten years have passed since Dr Alan Head, a solid-state physicist of the CSIRO's Division of Tribophysics, conceived the idea of a plate that continually radiates heat to outer space, but it remains a fascinating idea in search of an application.

Dr Head noticed that the Earth's atmosphere and certain materials such as silicon monoxide had approximately the same 'radiation window'. In other words, they only transmit heat radiation in a narrow range of wavelengths and this range is not in the region where most solar radiation energy is received. Thus, Dr Head reasoned, if a surface, exposed to a cloudless sky, could be made to radiate at these wavelengths and reflect strongly at other wavelengths, there would be a net loss of radiant heat to outer space.

Surfaces with these radiation characteristics can be made, for

(Continued on page 11)

SANSUI... SILENT SOUND SOURCE.

FUNDAMENTALLY, A PARADOX SELLS SANSUI TURNTABLES.

When you are listening to your favourite stereo recording played on a Sansui turntable you are quite unaware of the sound source. And isn't that the way it should be?
There are three models in the Sansui turntable range. All are silent, all share Sansui "*know-how*" and technology . . . and even the lowest priced model has a "wow" specification of *less than 0.07%*. Let's look at the three Sansui models:—

SANSUI MODEL SR1050C — MANUAL OPERATION.
● Belt drive ● Two speeds ● 4 pole hysteresis synchronous motor ● Push-button controls ● Dual purpose cueing control ● Precision built tone arm with a lateral balancer and an inside force cancelling device ● Induced magnet cartridge with a frequency response of 20-20,000 Hz. and an output of 5 mV. ● Wow — Less than 0.07% ● Removable dustproof acrylic cover ● Hand finished cabinet of selected walnut ● Recommended list price — $181.

SANSUI MODEL SR2050C — FOR AUTOMANUAL OPERATION.
● Belt drive ● 4 pole hysteresis synchronous motor ● Automatic lift and stop which is electrically operated — a detector circuit operates a relay/solenoid system ● Push-button speed controls ● Two speeds ● Cueing control ● Precision built statically balanced tone arm ● Induced magnet cartridge with a frequency response of 20-20,000 Hz. and an output of 5 mV. ● Wow — Less than 0.07% ● Removable dustproof acrylic cover ● Hand finished cabinet of selected walnut ● Recommended list price — $231.

SANSUI MODEL SR4050C — FOR AUTOMANUAL OPERATION.
● Deluxe two speed model ● Belt drive ● 4 pole synchronous motor ● Automatic lift and stop which is electrically operated — a magnetic reed switch and plunger gently lifts the arm and stops the turntable ● Push-button speed control ● Cueing control ● Statically balanced gimbal design tone arm ● Induced magnet cartridge with a frequency response of 20-20,000 Hz. and an output of 5 mV. ● Wow — Less than 0.06% ● Removable dustproof acrylic cover ● Hand finished cabinet of selected walnut ● Recommended list price — $320.

From these necessarily brief specifications you can see some of the advantages of a Sansui sound source. Get all the facts — see your franchised Simon Gray dealer. When you compare all the Sansui features . . . and hear the difference Sansui quality makes . . . you'll invest in Sansui!

SANSUI DISTRIBUTORS *Australia, excepting W.A.: Simon Gray Pty. Ltd. Head Office: 28 Elizabeth Street, Melbourne 3000. Tel. 63 8101*, Telex 31904. Sydney Office: 53 Victoria Avenue, Chatswood, N.S.W. 2067. Tel. 40 4522* Canberra Office: 25 Molonglo Mall, Fyshwick, A.C.T. 2609. Tel. 95 6524. Adelaide Office: 301 South Terrace, Adelaide, S.A. 5000. Tel. 23 6233 N.T.: Pfitzner's Music House, Smith Street, Darwin 5790. Tel. 3801. Qld.: Sydney G. Hughes, 154-158 Arthur Street, New Farm, Brisbane 4005. Tel. 58 1422. Tas.: K. W. McCulloch Pty. Ltd., 57 George Street, Launceston, 7250. Tel. 2 5322. W.A. Distributors: Carlyle & Co. Pty. Ltd., 1-9 Milligan Street, Perth, 6000. Tel. 22 0431. Sansui equipment is manufactured by: Sansui Electric Co. Ltd., 14-1, 2-chome, Izumi, Suginami-ku, Tokyo, Japan.*

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

Please rush me further information on the Sansui Model stereo sound source and the name of my nearest franchised Simon Gray dealer.

Name

Address Postcode

Sansui

SG-STT-372

Some expensive stereo sets actually sound like this.

And generally it's because of the speakers. No stereo in the world can sound better than the speakers allow it to. A point people all too easily forget. And which in the early fifties worried a Swede called Stig Carlsson.

So he built an audio-lab at the Royal Institute of Technology in Stockholm.

And there he created a unique research facility which he used to investigate the whole chain of sound reproduction. Speakers. Amplifiers. Tape recorders. Records.

On the basis of his research he came to a simple conclusion.

"The sound reproduction faults that are usually called speaker sounds are the obvious consequence of the way speakers have been designed."

And so Stig Carlsson designed totally new speakers. Free of 'speaker sounds'.

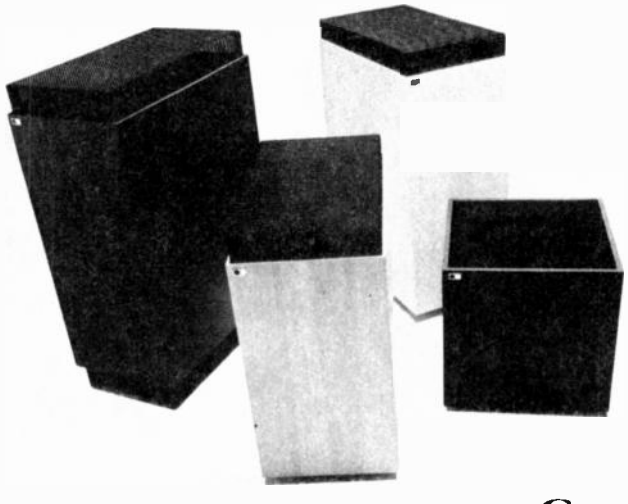
They were omni-directional. And that was years before anyone had even heard of that mildly trendy expression.

In the beginning they were available in kit form only. Now they are in full production. And they're covered by world-wide patents.

What are Carlsson speakers like?

They fill the whole room with music, evenly. You'll feel almost as though you are floating in sound. (Stig Carlsson describes this phenomenon in terms of plasticity, airiness, openness.)

Carlsson speakers were introduced into Australia barely a month ago. Write or phone us and we'll send you the Sonab literature and the name of your nearest dealer.



Please send me details of your equipment.

Name: _____

Address: _____

_____

_____ Post Code: _____

Sonab

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

Give your present stereo system a $500 sound for around $30

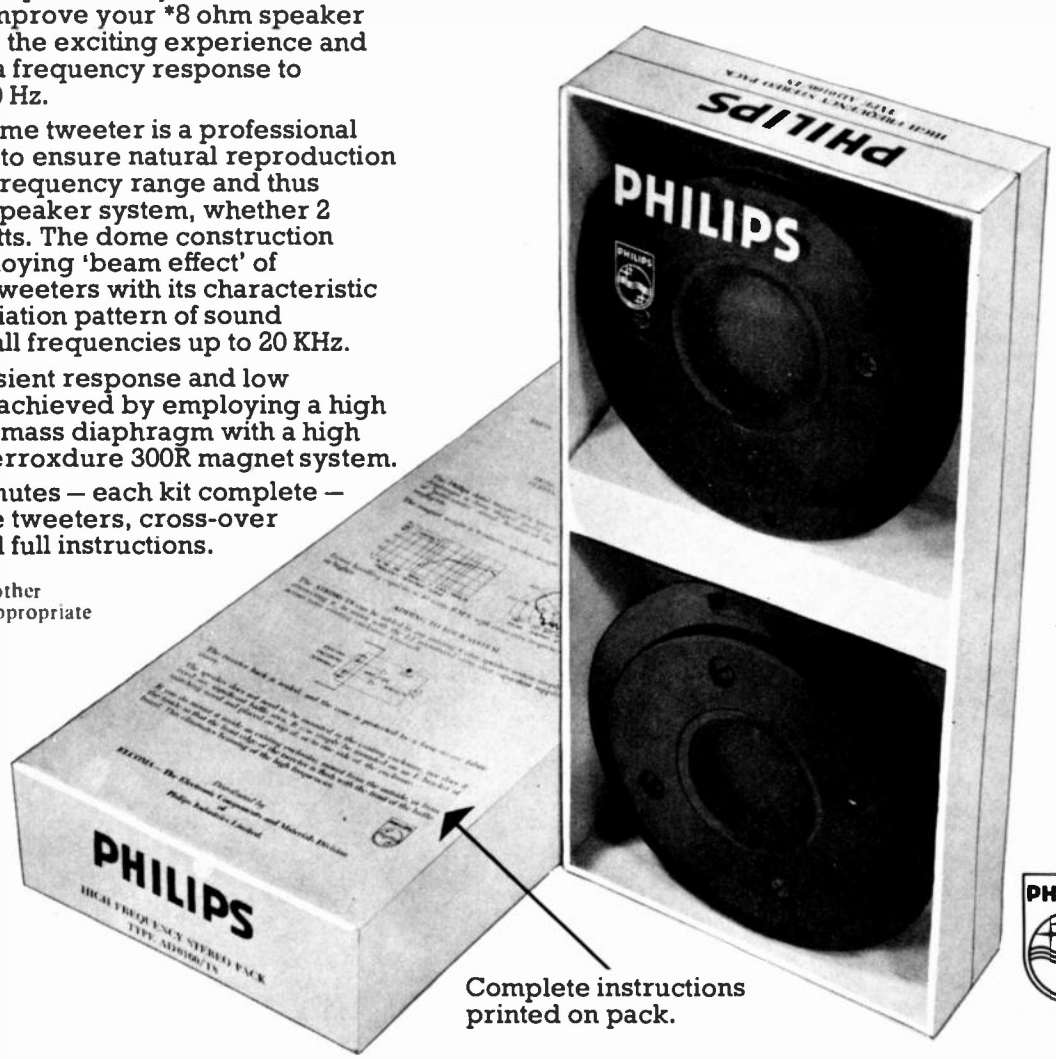
For a modest expenditure you can now significantly improve your *8 ohm speaker system to give the exciting experience and 'presence' of a frequency response to beyond 20,000 Hz.

The Philips dome tweeter is a professional unit designed to ensure natural reproduction over its wide frequency range and thus enhance any speaker system, whether 2 watts or 40 watts. The dome construction avoids the annoying 'beam effect' of conventional tweeters with its characteristic 180° polar radiation pattern of sound dispersion at all frequencies up to 20 KHz.

Excellent transient response and low distortion are achieved by employing a high efficiency low mass diaphragm with a high flux density Ferroxdure 300R magnet system.

Convert in minutes – each kit complete – 2 Philips dome tweeters, cross-over capacitors and full instructions.

*Suitable also for other impedances with appropriate cross-over values.



Complete instructions printed on pack.

PHILIPS

THE ELCOMA DIVISION
Electronic Components & Materials
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38.1731

news digest

(Continued from page 6)

example, by depositing a very thin layer of silicon monoxide on a highly polished surface of aluminium. If the sheet is thermally insulated from its immediate surroundings, the temperature of the sheet should fall.

Can this idea be put to work?

Independent work by Mr R.N. Morse, Chief of the CSIRO's Division of Mechanical Engineering, led to other speculations on the cold plate idea.

Mr Morse realized that transparent polyethylene sheet has a radiation window in about the centre of the region where the human body radiates most of its heat. A well-insulated cold plate with one surface covered with polyethylene should allow a person to lose heat to that plate without having to lower the temperature of the surrounding air. In this way, comfort cooling panels have been produced and tested.

But, suppose Dr Head's cold plates were used in a ceiling or wall panel of a room, with silicon monoxide on the outside, polyethylene on both inside and outside, and the entire plate insulated against heat flow from its surroundings. Would this radiant heat exchanger enable people to keep cool in the tropics without air-conditioning by radiating to the deep cold of outer space?

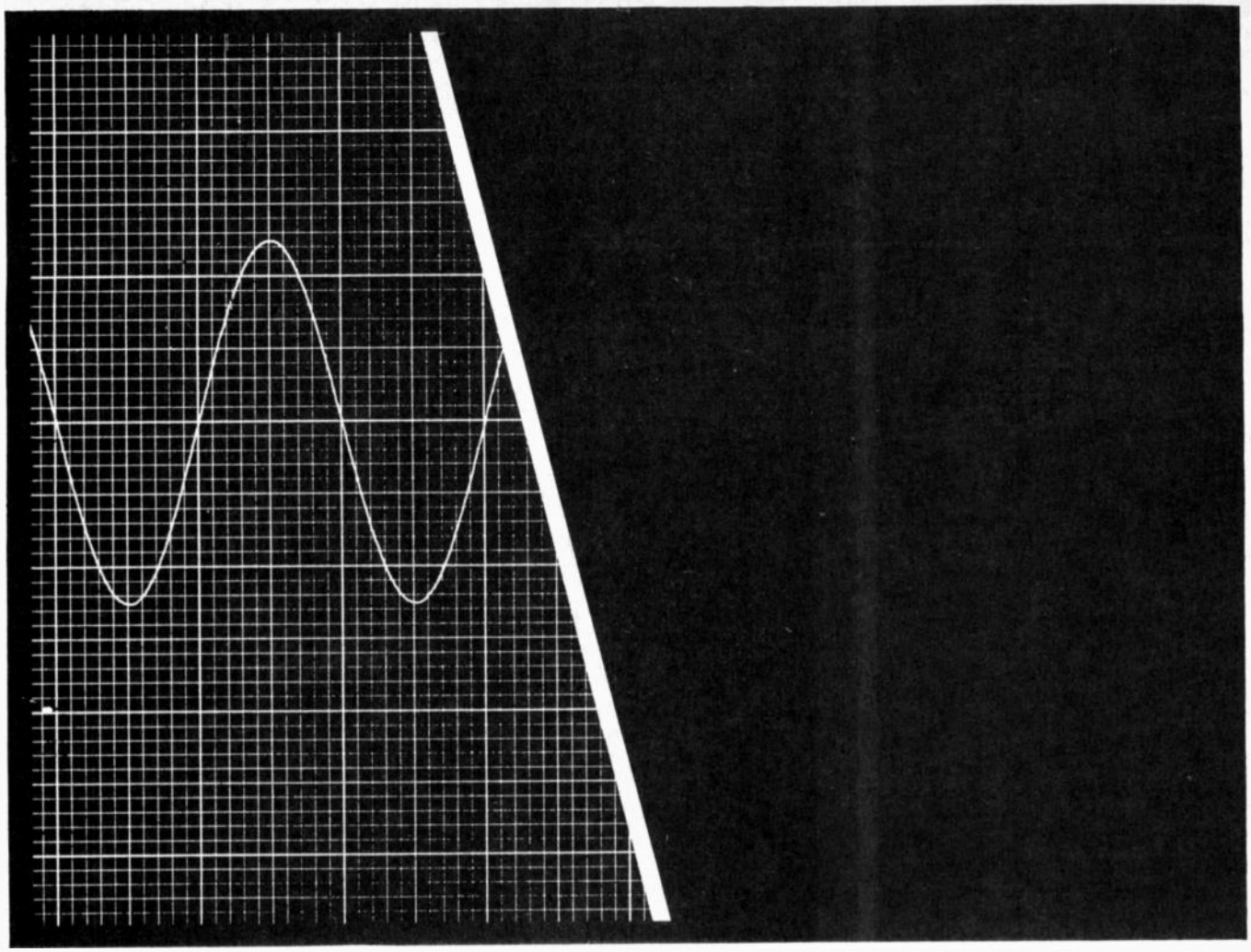
The answer would appear to be, for all practical purposes, no.

The National Research and Development Council of Britain and the National Research Corporation in the United States have been looking for people to take up the radiant cold plate idea and make it work. However, because the radiant intensity is so low, large areas are required and the fact that dull weather 'closes' the radiation window combines with other obstacles to ensure that the eternally radiant cold plate remains just a fascinating idea idea.

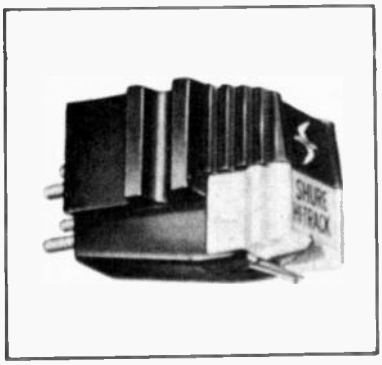
ECOLOGICAL CITROEN

In France, Citroen are working jointly with the Total petroleum company to produce an electrically powered commuter type vehicle. Surprisingly, present development is concentrated on producing a 'clean' efficient fuel cell, rather than high energy density batteries.

The long term objective, according to a company spokesman, is for the power source to take in dirty air and exhaust clean air!



Finally! A visually perfect sine wave!



The sine wave above was generated by Shure's Design Computer – the NEW Shure Model M91ED and Model M91GD Hi-Trackability Cartridges can reproduce a sine wave which looks the same. This new series of improved M91 Hi-Track cartridges offers sound re-creation performance never before available in their price class! Gem-quality diamond tip is "nude-mounted" directly on the stylus bar (without a mass-increasing metal bushing) to reduce effective stylus tip mass – and improve trackability. Deluxe molded housing assembly. Shure Model M91ED – Bi-Radial Elliptical ¾ to 1½ grams R.R.P. 55.00; Shure Model M91GD – Spherical Dynetic .0006 ¾ to 1½ grams R.R.P. 45.00. SPECIAL NOTE: Present owners of M91 and M93 cartridges can upgrade their cartridges and obtain the superior performance of the new M91ED by using the new N91ED stylus assembly. Write Audio Engineers Pty. Ltd., 342 Kent Street, Sydney. 2000. 29 6731.

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news digest

NEW PHONE ENABLES DEAF TO "SEE" MESSAGES – THE DEAF AND BLIND TO "FEEL" THEM

A new telephone which will allow the deaf to "see" messages in coded flashes of light and the blind to "feel" them in the vibrations of a finger pad is being developed for by Bell Telephone at their Indianapolis, New Jersey laboratories.

Called the Code-Com set, it is one of two new 'phones which will make calling possible for handicapped persons. The second is a set with a volume control receiver for public coin telephones.

The Code-Com set is for people who are totally deaf, deaf and blind, or deaf and mute. It consists of a conventional telephone and a signal unit containing a light bulb, a vibrating disc, and a sending key.

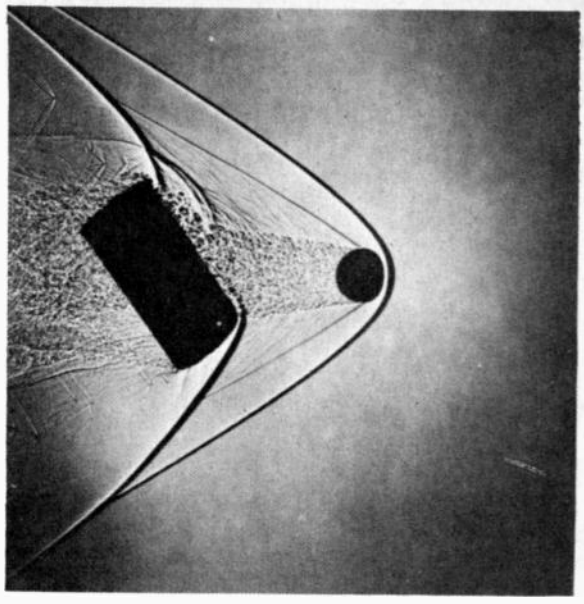
While a telephone ordinarily converts speech into electrical impulses which are transmitted and reconverted to speech at the receiver, the Code-Com set converts the transmitted signals into flashes of light and vibrations of the disc or sensor pad. Thus, a deaf or deaf and blind person can "read" simple messages by using a question and answer system, or more complex messages by using a pre-arranged code such as Morse code. Using the sending key like a telegraph key, a person without normal speech can send light or vibration signals to another Code-Com set or coded sound signals to a regular telephone.

The Code-Com set may be used with a separate signal control unit, which is connected to the ringing circuitry of a conventional telephone. A telephone "ring" is indicated when the control unit switches a light, electric fan, or some other light-duty appliance on or off.

Field trials of experimental models of the Code-Com set have been held in Indianapolis, New York City and Columbus, with the assistance of handicapped persons and local telephone companies. After some practice with Morse code users were able to attain sending and receiving speeds of about 10 words per minute.

The second set – the volume control handset – is being developed for public phone locations, such as bus, train, and airline terminals, where it must serve customers with normal hearing as well as those with impaired hearing. Customers with impaired hearing can use a three-position switch to increase the volume of sound from the receiver. Persons with normal hearing can use the phone at either normal volume or amplified volume for noisy booth locations.

news digest



HIGH SPEED SHADOWGRAPH

This remarkable photograph of a steel ball (and wooden blank) fired from a 37 millimetre cannon, has captured their shadow as they pass between an electrical spark and a sheet of film. This shadowgraph was exposed for slightly less than one millionth of a second.

The new electro-photographic technique was developed by the Canadian National Research Council's Division of Mechanical Engineering.

ELECTROTECHNOLOGY DRAFT STANDARD

The Standards Association is seeking comment on a draft Australian standard for diagrams, charts and tables used in electrotechnology, issued as Doc. 1878.

The draft defines and classifies these diagrams, charts and tables in order to explain or display the functions or connections of electronic equipment. Classification by purpose and by method of representation are demonstrated.

These definitions are in line with those proposed by the International Electrotechnical Commission in their Publication 113 and those of BS 3939.

Copies of Doc. 1878 may be obtained without charge from the various offices of the Standards Association in all capital cities and Newcastle.

Comment on the provisions of the draft is invited from persons or organizations experienced in the preparation and uses of such diagrams, and should reach head office of the Association, 80 Arthur Street, North Sydney, NSW, 2060, not later than 31 March 1972.

POOL ALARM CONTEST

Initial judging of our swimming pool alarm contest has now been practically completed and finalists will be asked to submit prototype designs within the next few weeks.

Variations on an original theme... with Silcron!

Although it's only two years since the very first Silcron turntable was released, this economical and noise-free belt driven turntable has captured a substantial percentage of the Australian hi-fi market. The original Silcron Mk. III appeals to the hi-fi enthusiast who demands perfection yet is cost-conscious; without doubt it is the finest turntable available at the price.

Like all engineers who are also perfectionists, the designers of the original Silcron turntable have recognised the need for a deluxe model. And so we release the new Silcron Mk. IV "Isophonic" Series. It combines all the proven attributes of the Mk. III with new design and engineering features which make it the most outstanding turntable available in Australia today . . . no other turntable offers as much performance for relatively low cost.

FEATURES OF THE SILCRON TURNTABLES:—

SILCRON MK. IIL

- Sealed 12 pole synchronous motor.
- Belt drive . . . noise-free.
- Wow and flutter — less than 0.04%.
- Lightning fast speed change.
- Two speeds — 33⅓ and 45 r.p.m.
- Dynamically balanced cast aluminium turntable platter.
- Only 3 moving parts.
- Anti-static mat at no extra cost.
- Height above motor board — 2".
- Precision engineering throughout.

SILCRON MK. IV "ISOPHONIC" SERIES.

- New sealed 8 pole 750 r.p.m. synchronous motor.
- Belt drive . . . noise-free.
- Wow and flutter — less than 0.04%
- Lightning fast speed change.
- Two speeds — 33⅓ and 45 r.p.m.
- Dynamically balanced cast aluminium turntable platter.
- Four times the power of the Mk. III.
- New centre bearing shaft assembly.
- Acoustically insulated turntable platter and pick-up assembly which eliminates acoustic feedback.
- Tone arm tracking is constant.
- New vibration absorbent anti-static mat.

CHOICE OF MODELS —

SILCRON MK. III.

- Basic turntable only, unmounted.
- With motor board and timber base.
- With independently sprung motor board, dustproof perspex cover, professional tone arm and magnetic stereo cartridge.

SILCRON MK. IV

- Basic turntable, unmounted.
- With professional quality tone arm.
- With attractive oiled teak base.
- With professional tone arm and attractive oiled teak base.

Note: Dustproof perspex covers and spring mounted timber bases are available for both Silcron models.

ASK FOR A DEMONSTRATION!

See your franchised Simon Gray dealer. *You'll find it costs very little to step up to Silcron!* Service facilities are available in all states and spares, if ever required.

Australian National Distributors:

Simon Gray Pty. Ltd.

Head Office: 28 Elizabeth St., Melbourne Vic. Tel. 63 8101 * Telex: 31904
Sydney Office: 53 Victoria Ave., Chatswood, N.S.W. Tel. 40 4522*
Canberra Office: 25 Molonglo Mall, Fyshwick, A.C.T. Tel. 95 6528
Adelaide Office: 301 South Terrace, Adelaide S.A. Tel. 23 6219

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Tas.: K. W. McCulloch Pty. Ltd., 57 George Street, Launceston Tel. 2 5[illegible]2
W.A.: Athol M. Hill Pty. Ltd., 613-615 Wellington Street, Perth. Tel. 21 [illegible]61

ET-STT-472

"Industrial espionage is a serious subject, far more serious than we suspect" — Sir Richard Powell, Bt. M.C. Director-General, Inst. of Directors.

WHAT'S

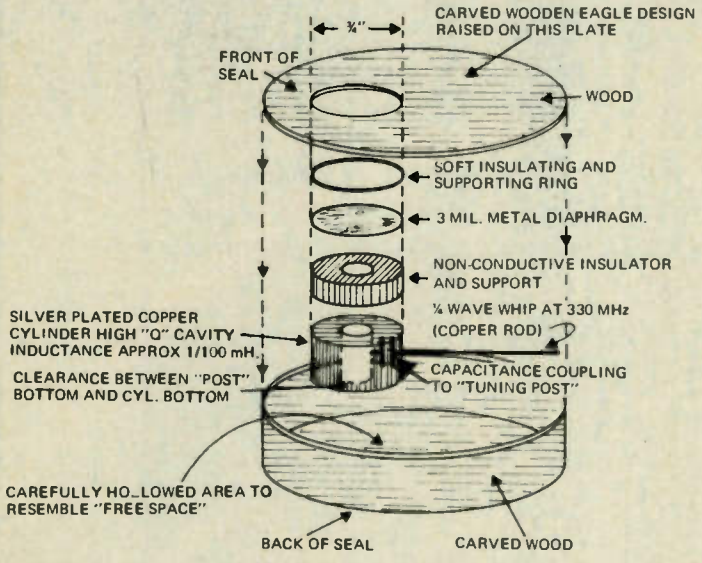


Fig. 1. Probably the most famous, bug of all time, this ingenious device contained an externally energized uhf cavity and was implanted by the Russians in the US Embassy in Moscow.

"Industrial espionage is very rarely committed as a deliberate act of board policy. It is almost invariably initiated by senior sales or marketing personnel and concealed from the top management". — Leading US security agent.

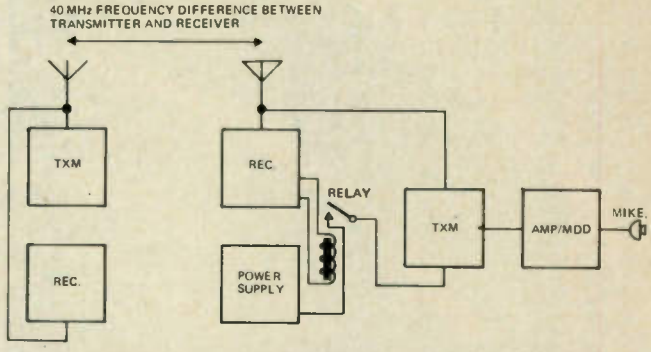


Fig. 2. This bug was planted in the office of the US Under-Secretary for State in 1966. A remotely operated transmitter was used to send a switch-on signal to the implanted bug, and thus extend battery life.

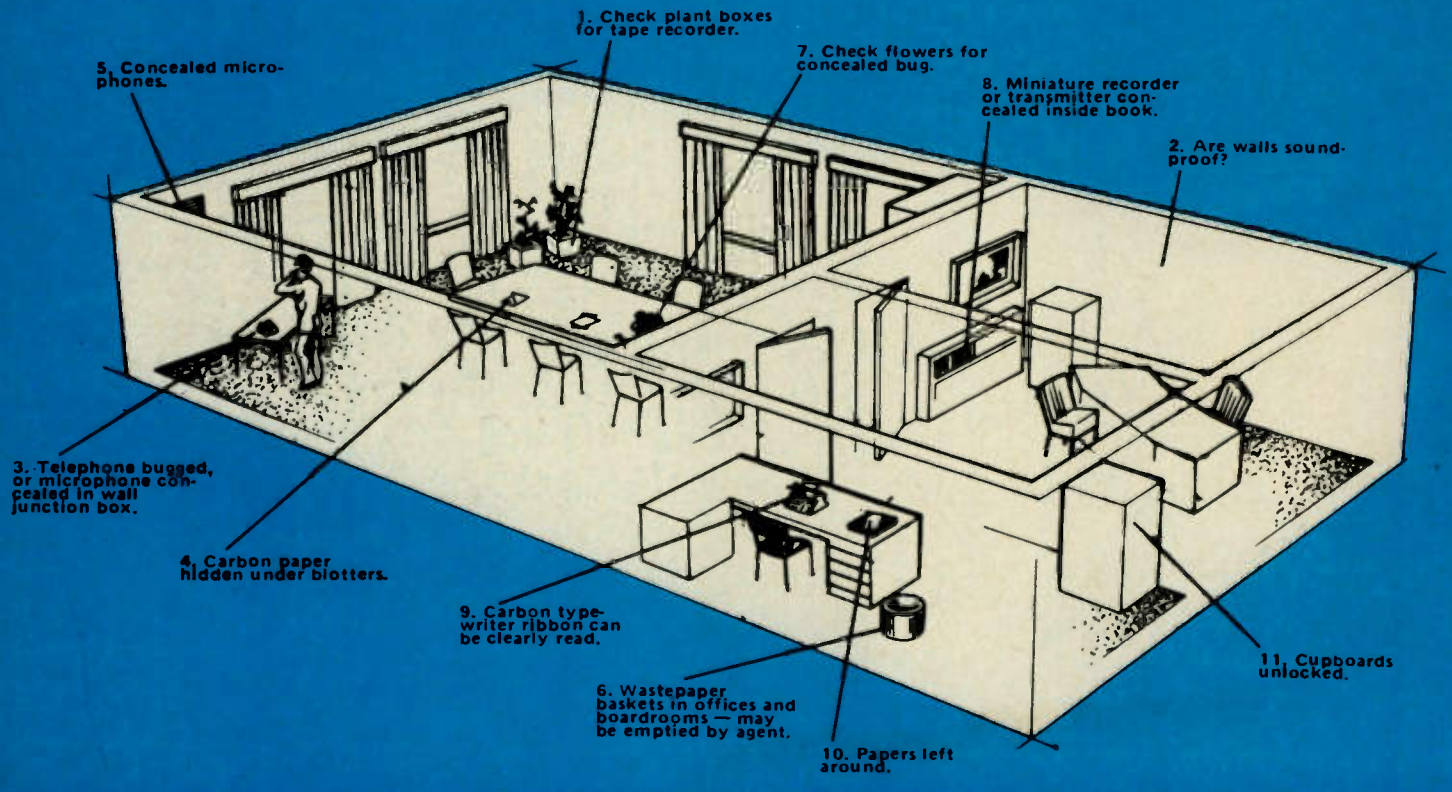


Fig. 3. This drawing shows the most common ways of gaining access to confidential information.

BUGGING YOU?

– a serious look at industrial espionage

In 1945, the Soviet Government presented Averill Harriman – then US Ambassador to the Soviet Union – with a magnificantly carved American Great Seal (Eagle) for the newly built USA Embassy in Moscow.

Subsequently, it was discovered that the Russians' motives were somewhat less than altruistic, for the Great Seal contained one of the most ingenious bugs yet devised.

Brilliant in its simplicity, this bug was a ¾" diameter, silver-plated copper cavity capacitively coupled to a ¼ wave antenna also concealed within the wooden carving.

A thin metal diaphragm sealed one end of the cavity. Any speech within the room containing the bug would modulate this diaphragm, which in turn would change the resonant frequency of the cavity.

The cavity was energised by radiated rf – at the normal static frequency of the cavity – and then as the diaphragm moved – the cavity in effect behaved as a modulated oscillator.

The cavity was energized at 330 MHz by a small transmitter and narrow-beam high-gain antenna concealed within a van parked outside the Embassy grounds.

Another nearby vehicle, also equipped with a narrow-beam high-gain antenna, tuned in to the bug and detected the modulated 330 MHz signal.

After many years service, the bug was discovered by some British technicians who accidentally tuned across its operating frequency. (In the resulting brouhaha the CIA also uncovered no less than 60 other microphones hidden throughout the Embassy building).

Figure 1 shows our artist's impression of this now famous bug – which was shown to the UN in 1960 by Henry Cabot Lodge. (The wooden carving has now been replaced by a new – and hopefully, non-performing, Seal).

As the reader will appreciate, this system required neither maintenance, nor internal power source, and operated only when the cavity was energized by external rf energy at exactly the right frequency.

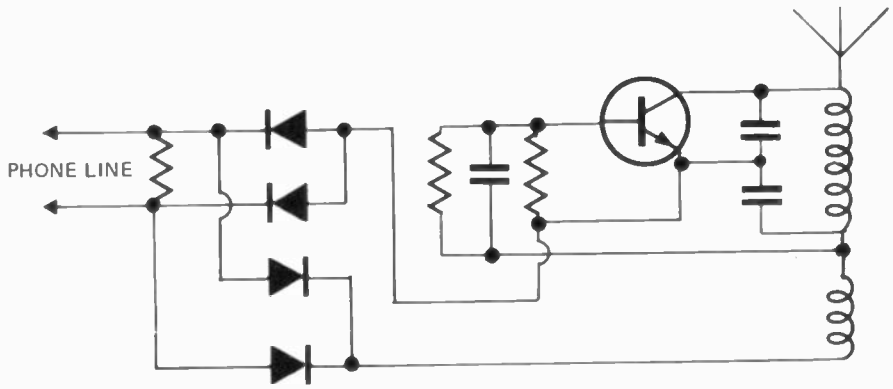


Fig. 4. This is the most common type of telephone bug. It is often incorporated within the existing microphone of the telephone handset and derives both its modulation and power from the telephone system. The antenna is usually capacitively or inductively coupled to the phone lines.

In 1966, two Communist Czechoslovakian diplomats were charged with attempting to bug the offices of US Under Secretary for State, George W. Ball.

The eavesdropping system that they used is shown, schematically, in Fig. 2. The implanted equipment is shown to the right of the drawing. A remotely operated transmitter was used to send a 'switch-on' signal to the implanted bug. When this signal was received, a relay in the bug closed and connected the inbuilt batteries to the remainder of the equipment. This technique extended the life of the inbuilt mercury batteries many times over.

Once again this bug was found, not because of US bug detectors, but from information received from political enemies of Czechoslovakia.

To many of our readers it may come as quite a surprise to hear that industrial espionage methods only slightly less sophisticated than those just described are used, to an ever-growing extent, throughout the world.

The term 'industrial espionage' is emotive. It is intensely disliked by its practioners, who prefer the euphemism 'aggressive market research', which they define as the practise of securing knowledge about competitors by any and every possible means.

Generally, industrial espionage operates on a non-technical basis, relying on simple well-proven techniques of bribing employees, obtaining access to private documents, board reports, salary files etc. Other, rather more sophisticated methods are detailed in Fig. 3 on page 16.

But despite the more common non-technical approach there are many occasions when very sophisticated electronic equipment is used. In fact the manufacture of this equipment has become big business for over 50 large companies (mainly, but not exclusively, in America), and several of these companies back the field both ways by also producing a range of bug detectors.

Circuits and schematic diagrams shown in this article are included solely to clarify the written text. For obvious reasons, 'bug' circuits have been shown without component values and with minor components excluded.
Again, for obvious reasons, neither the Editor nor any member of our staff will enter into any correspondence relating to the construction or installation of this type of equipment, the use of which is generally illegal.

WHAT'S BUGGING YOU?

PMG employee — or?

A telephone can never be considered secure.

In most countries, Government security organisations use direct wire tapping, or rearrange the phone wiring using an elementary 'third wire' technique so that the microphone becomes 'active' even though the handset is on the rest.

TELEPHONE TAPPING

Industrial espionage agents generally use more elaborate methods, for the direct wire tapping techniques draw current from the telephone lines and are readily detected by conventional telephone line monitoring equipment.

The most commonly used telephone bug is a small transistor oscillator — operating around 90 MHz — mounted on the back of a standard telephone microphone insert, or actually built into a standard insert. Either way the bug is a direct plug-in replacement for the standard microphone insert and can be fitted in a second or two. The bug is powered by the telephone line current and, if undetected, can operate practically for ever. The telephone line itself acts as an antenna.

The bug's operating range is of course limited by the lack of a tuned antenna. Normally, coupling to the local telephone lines provides a range of less than half a mile The schematic circuit of the most commonly used unit of this type is shown in Fig. 4. (Engineers will notice that we have deliberately omitted one or two components from all schematics shown in this article — nor are component values given — our reasons for doing this are obvious). In this circuit, the transmitter is modulated by the rectified but unfiltered telephone line voltage upon which is impressed the voice frequencies existing on the line.

Yet another telephone bug utilises the magnetic field that exists around the hybrid transformer in the base of the telephone handset. The bug, often disguised as a 'telephone diary', or ashtray, is placed close to the telephone so that an inbuilt coil can detect the handset's local magnetic field. Following detection and amplification, the signal is then sent to a nearby receiver via a miniature FM transmitter operating in the 88 to 108 MHz band. A more 'refined' version of these units inccorporates a miniature microphone, so that room conversations as well as telephone conversations may be detected.

Perhaps the most ominous of all telephone tapping devices is one known as the 'infinity transmitter'. The device has almost 'infinite' range, hence its name, and can be used over telephone lines thousands of miles long.

A block schematic diagram of the infinity transmitter is shown in Fig. 5. The actual bug consists basically of a frequency sensitive decoder that actuates a miniature multi-pole relay. The eavesdropper has a tone generator with an audio output that he holds to his telephone mouthpiece immediately after dialling his victim's number. The moment this tone is decoded by the bug, the relay is actuated; this simultaneously opens up the bell ringing circuit and connects the handset's transmitter and receiver to an inbuilt audio amplifier the output of which is connected to the telephone line.

Thus the victim's telephone bell is deactivated before it can ring, and his telephone handset now transmits all sound within the room to an eavesdropper who may be thousands of miles away, *whilst the handset is still on its rest.* If a third party rings the number whilst the bug is operating he receives the normal 'busy tone'.

Infinity transmitters are difficult to

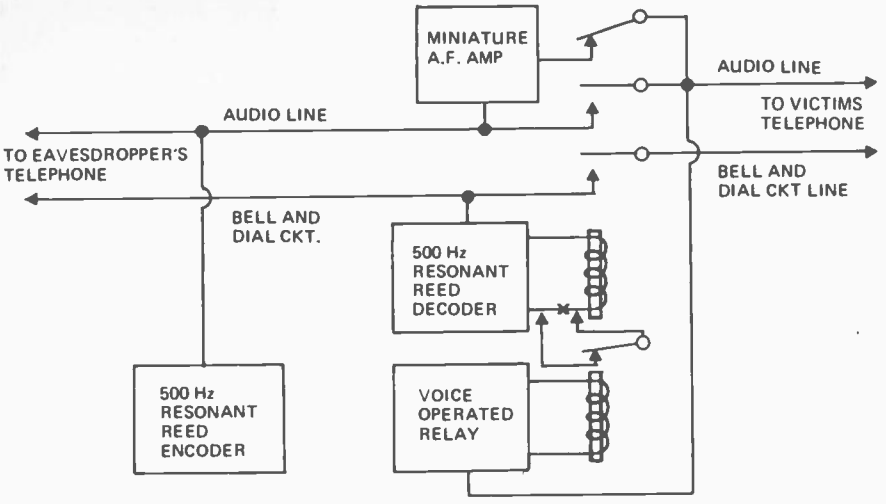


Fig. 5. Block schematic drawing of infinity transmitter. This bug enables an eavesdropper to listen to sounds within a room thousands of miles away.

detect as the electronic tone decoding equipment may be located some distance from the telephone. One method, commonly used in the USA, is to sweep the telephone line with an audio oscillator – meanwhile checking the voltage across the line. A tone operated bug will cause a significant dip in the line voltage.

Yet another method of detecting these bugs is to dial the number of the suspect telephone – having first arranged that it is not answered – and then to sweep the line with the oscillator – this will energize the tone operated relay and cause the number to stop ringing. (Fig. 6 shows a detector specifically developed for this purpose.)

One certain defense against the infinity detector is to use an extension telephone that is connected through a manually operated switchboard, for this type of bug can only be used on direct lines. It is ironic that many senior executives prefer direct lines in a mistaken belief that this provides them with a higher level of security!

If one's line does not go via a manual switchboard, the only other successful defense is to install a white noise generator, with an audio output, close to the mouthpiece of the telephone handset. If your telephone is being bugged then this will saturate the line and prevent speech being understood.

Normally of course, the white noise generator cannot affect the telephone system in any way for the telephone is disconnected from the line until lifted from the handset.

It is practically impossible to estimate the extent to which telephone tapping occurs in this country. But our own discrete enquiries indicate that it is far more common than we had previously believed.

The miniature electronic bugs, featured so often in spy stories and films are very much a reality.

TRANSMITTERS AND RECORDERS

They consist of a small radio transmitter (usually FM), a hearing aid microphone and batteries. They have a range of about 400 yards and sound can be picked up within 20 to 30 feet of the microphone.

Another variation uses a flexible plastic tube fastened to the front of the microphone. This is done not only to enable the microphone to be installed in 'difficult' locations, but also to prevent the microphone or transmitter being located by metal detectors.

Other types of detectors are used to receive sounds through concrete and brick walls. One type commonly used is based on a record player cartridge and stylus, it works very well, providing no-one drops something heavy on the floor, or bangs the wall that is being bugged. Either happening is prone permanently to deafen the eavesdropper. (The US manufacturer of this device has apparently not heard of clipping circuits).

The FM transmitters used in these bugs are very simple, many are based on tunnel diode oscillator circuits such as that shown (incomplete) in Fig. 7

Power for these transmitters is usually derived from miniature batteries, and to conserve battery power the more sophisticated units incorporate circuitry that switches on the transmitter only when there is a sound signal to transmit.

Another power source occasionally used consists of what is basically a simple tuned circuit, diode and large storage capacitor. The source is connected to a short antenna and when tuned to a local broadcasting station, receives and stores sufficient power to operate a low powered bug practically for ever. (Fig. 8)

Many microphone/transmitter bugs openly on sale in the USA and UK are built inside or around furniture and electrical fittings and appliances.

One company, Mosler Research Products, manufacture a range of framed pictures. A microphone concealed within the moulding receives sound signals via a number of strategically placed holes in the frame, whilst extra long-life batteries are evenly placed so that the complete picture has a balanced feel. The pictures are said to be presented to the victims as gifts.

Other companies, manufacture bedside lamps, pencil sharpeners, an; other electrical devices incorporating inbuilt microphones and FM transmitters; generally the power cord doubles as the antenna.

A number of American companies also produce domestic radio sets constructed so that when switched off, the speaker acts as a microphone. Additional circuitry within the set transmits the received voice signals – again using the power cord as an antenna.

DETECTING RADIO TRANSMITTER BUGS

Fortunately it is fairly simple to detect the presence of radio transmitter bugs.

The simplest and most efficient way is to use a portable FM receiver to establish an acoustic feedback loop. The receiver must cover the complete FM band – ideally it should range

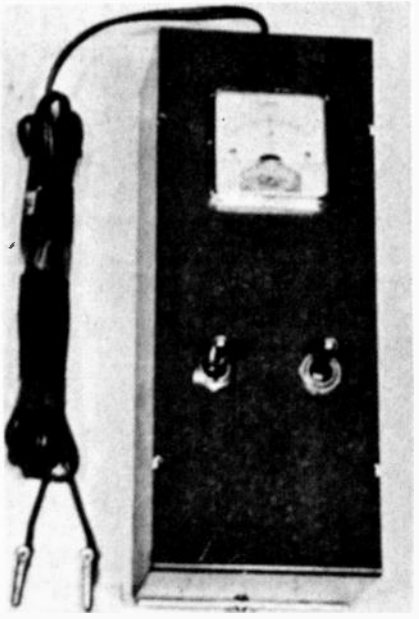


Fig. 6. This device, manufactured in the USA, is specifically designed to detect infinity transmitter devices.

from 40 MHz to 300 MHz – and should have good sensitivity.

To check for bugs, switch on the receiver and turn the volume control to a high setting. Pull out the antenna and then smoothly and *very slowly* sweep the tuning control over its entire range. This *must* be done slowly – taking about four or five minutes to cover the range.

If the room has been bugged with a radio transmitter, at some point along the tuning scale a howl will be heard in the receiver caused by feedback between the loudspeaker and the concealed microphone. It may be necessary to repeat the operation at several points if the room is larger than 15ft. square.

The actual location of the bug can be found by decreasing the volume control setting until the howl just stops and then tapping a pencil on various surfaces in the room. The tapping signal will be quite clearly heard in the receiver as one approaches the microphone's location.

Do not use an earphone for this procedure – the receiver's loudspeaker is an essential part of the acoustical feedback loop.

Another detection method – commercially available for a few hundred dollars – uses a straightforward rf field detector (Fig. 9). In this circuit a tunnel diode is used as an untuned broadband detector (a sensitivity control ensures that the device is not triggered by local broadcasting stations). The detector is used to sweep the required area, and if it detects an rf field, the tunnel diode circuit causes an audio oscillator to generate a loud warning signal.

Technicians should always bear in mind that experienced industrial espionage operators nearly always install more than one bug. If one is detected, it is almost certain that others will be around.

Many large organisations – rather than attempting to solve their possible bugging problems – merely trample them to death by installing rf white noise generatorsrs. These flood the surrounding area with rf noise and effectively jam any radio transmitter within several hundred feet. These rf generators are at least as antisocial as the bugs against which they afford protection, for they jam all radio signals within their area – legitimate or otherwise. But several companies are known to have even used spark gap transmitters for this purpose.

SECURE ROOMS

The best protection against microphone/transmitter bugging is probably that used by many governments for high security areas – especially in their overseas embassies. This consists of prefabricated rooms of which the walls are constructed from layers of acoustical and rf screening material. Any power lines entering the room are fitted with by-pass capacitors to remove all rf signals. No telephones are installed.

The rooms are thoroughly checked after manufacture and then re-assembled as a 'secure' area within an existing room.

This may appear to be going to extreme lengths to protect against a probably non-existent problem – but in Sydney, one company, by no means known for industrial paranoia, uses a room of this type for its board meetings and other top-level discussions.

SHOT-GUN MICROPHONES

These have been developed from the directional microphones used by radio and film recording companies. They consist of a microphone transducer with a series of tubes of various lengths mounted in front of the microphone diaphragm. The tubes vary in length from two inches to 60 inches and are bound together to form a rigid structure (Fig. 10).

Sound originating on the axis of the tubes first enters the longest tube and then successively enters each shorter tube in order of tube length. Thus all sounds originating from the front of the device travel the same distance and arrive at the microphone diaphragm in the same phase relationship.

Any sounds originating at, say, right angles to the tubes, enter all tubes simultaneously, thus a sound entering the longest tube may travel five feet before it reaches the microphone, whilst the same sound entering the shortest tube may travel only an inch or two. Thus off-axis sound will arrive at the microphone with varying phase relationships and considerable sound cancellation will occur.

A well designed shot-gun microphone can readily pick up a conversation across a wide street, and will be so

(Continued on page 87)

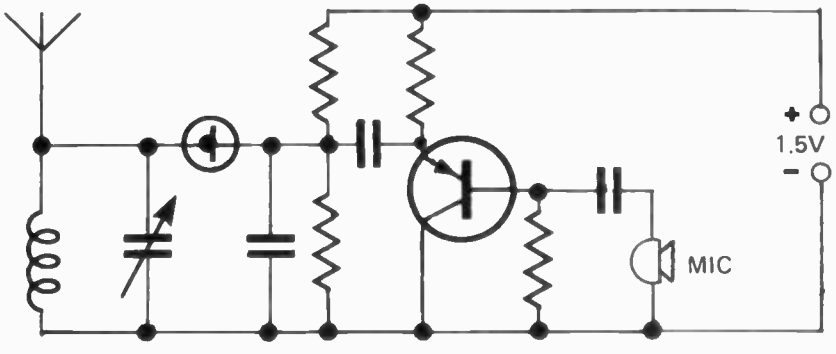


Fig. 7. Typical of simple FM bugs, this device uses a tunnel diode oscillator and radiates in the 90 – 100 MHz band.

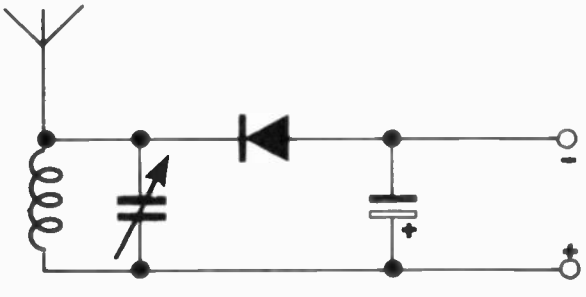


Fig. 8. Simple rf receiver provides 'free' power for implanted bugs.

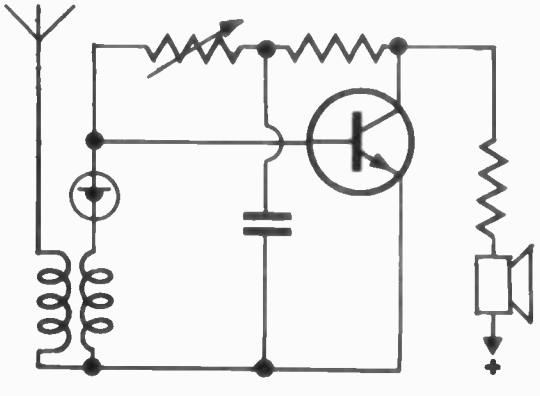


Fig. 9. This is an rf field detector frequently used to detect and locate concealed transmitters.

The black vehicle has electronically controlled braking.

Electronic Anti-Skid Braking

Electronically controlled braking system ensures optimum deceleration regardless of surface conditons.

In our October (1971) issue we forecast that an electronic anti-braking system for automobiles would be in production in the near future.

This has now happened and a system basically similar to that we described will be optionally available on Mercedes-Benz commercial vehicles, buses and their 350 SL passenger car from next month.

Despite the recent introduction of twin hydraulic circuits, practically fade-free disc brakes and anti-rear wheel locking valves, Mercedes-Benz felt that too much reliance was placed on the driver to assess and remain within the confines of the physical laws of friction.

Locked wheels do not have directional stability. Their braking efficiency is also less than with wheels braked to within a fraction of locking.

OPTIMUM BRAKING

The co-efficient of adhesion of a tyre – which, when multiplied by the wheel load gives the braking power – is dependent on tyre slip. If the tyre turns freely in relation to vehicle speed, the slip is zero and the transferable braking power is zero.

With a slip of 10 to 15% (that is to say, when the wheel turns 10 to 15% slower than the corresponding vehicle speed), the coefficient of adhesion, and therefore the braking power reach a maximum.

If the slip is higher, the co-efficient of adhesion decreases, and with 100% slip, i.e. when the wheel is locked, it is generally at a minimum.

Only on ice is the co-efficient of adhesion curve generally horizontal.

With these facts in mind, Mercedes-Benz considered that further improvements in braking performance could only be achieved through an automatic system that ensured the optimum application of braking effort for all road and tyre conditions during an emergency stop.

HOW THE SYSTEM WORKS

As soon as a wheel begins to lock up as a result of excessive pressure on the brake pedal, the automatic control system reduces the braking force to such an extent that the gripping capacity of the tyre is not exceeded even if full brake pedal pressure is applied.

The components of the system are shown in Figs. 1 and 2.

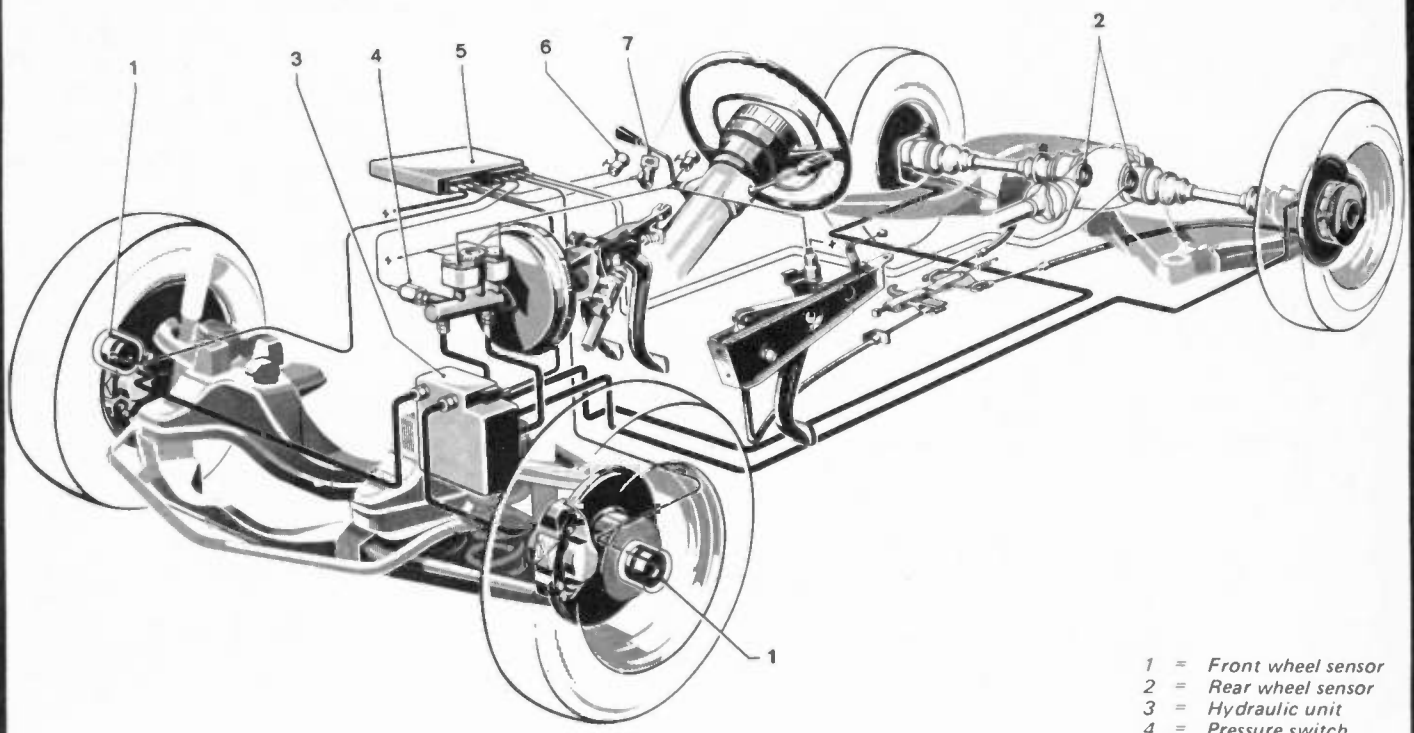
Fig. 1 shows the arrangement of the electronic sensing and control circuits. The schematic diagram (Fig. 2) shows the layout of the hydraulic part of the system.

If a wheel tends to lock up as a result of excessive pressure on the brake pedal, its rotational speed decreases very rapidly. A digital signal, proportional to wheel velocity, is sent by a digital transducer in each wheel to an electronic control unit. A differentiating circuit within the control unit converts this digital (velocity) signal into a voltage proportionate to deceleration.

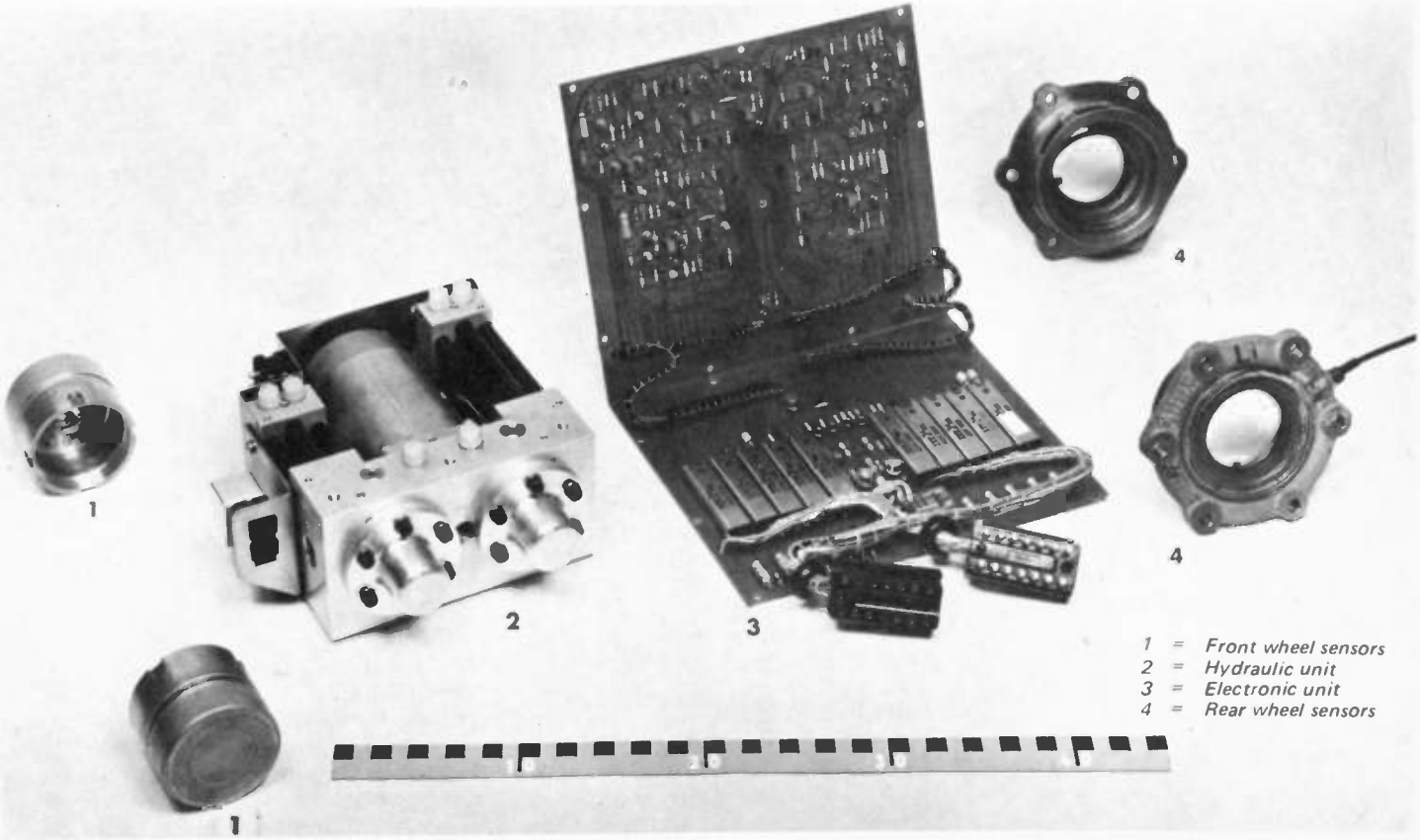
This voltage is then compared with a predetermined highest permissible value (roughly proportional to a *wheel* deceleration of 1.3G). If this level of deceleration is exceeded, a control signal is instantly transmitted to an electro-magnetic valve that in turn reduces the pressure of the brake fluid on the appropriate wheel.

As soon as this happens, the wheel,

FIG. 1 HOW THE ELECTRONIC SENSING AND CONTROL SYSTEMS ARE INSTALLED



1 = Front wheel sensor
2 = Rear wheel sensor
3 = Hydraulic unit
4 = Pressure switch
5 = Electronic unit
6 = Warning light
7 = Starter switch



1 = Front wheel sensors
2 = Hydraulic unit
3 = Electronic unit
4 = Rear wheel sensors

now receiving less braking power, accelerates again. This is registered by the wheel's sensor, and again the control unit reacts and brake line pressure is re-applied until speed drops once again and the cycle begins anew.

To fully appreciate the operation of this system it should be clearly understood that the wheel sensors are monitoring *wheel* deceleration and not necessarily vehicle deceleration. At low braking efforts the two levels of deceleration will be virtually the same, but the instant that the wheel begins to lock, the wheel deceleration becomes many times greater than the vehicle deceleration and this is registered instantly by the electronic control unit. This technique ensures that the optimum level of deceleration will apply regardless of the co-efficient of friction of the road surface.

THE CONTROL SYSTEM IN ACTION

With conventional brakes, a car can be stopped from 60 mph within 160 feet. Using the Mercedes system the same car on the same road can be stopped within 138 feet. The reduction by 24 feet corresponds to a 16% increase in braking efficiency.

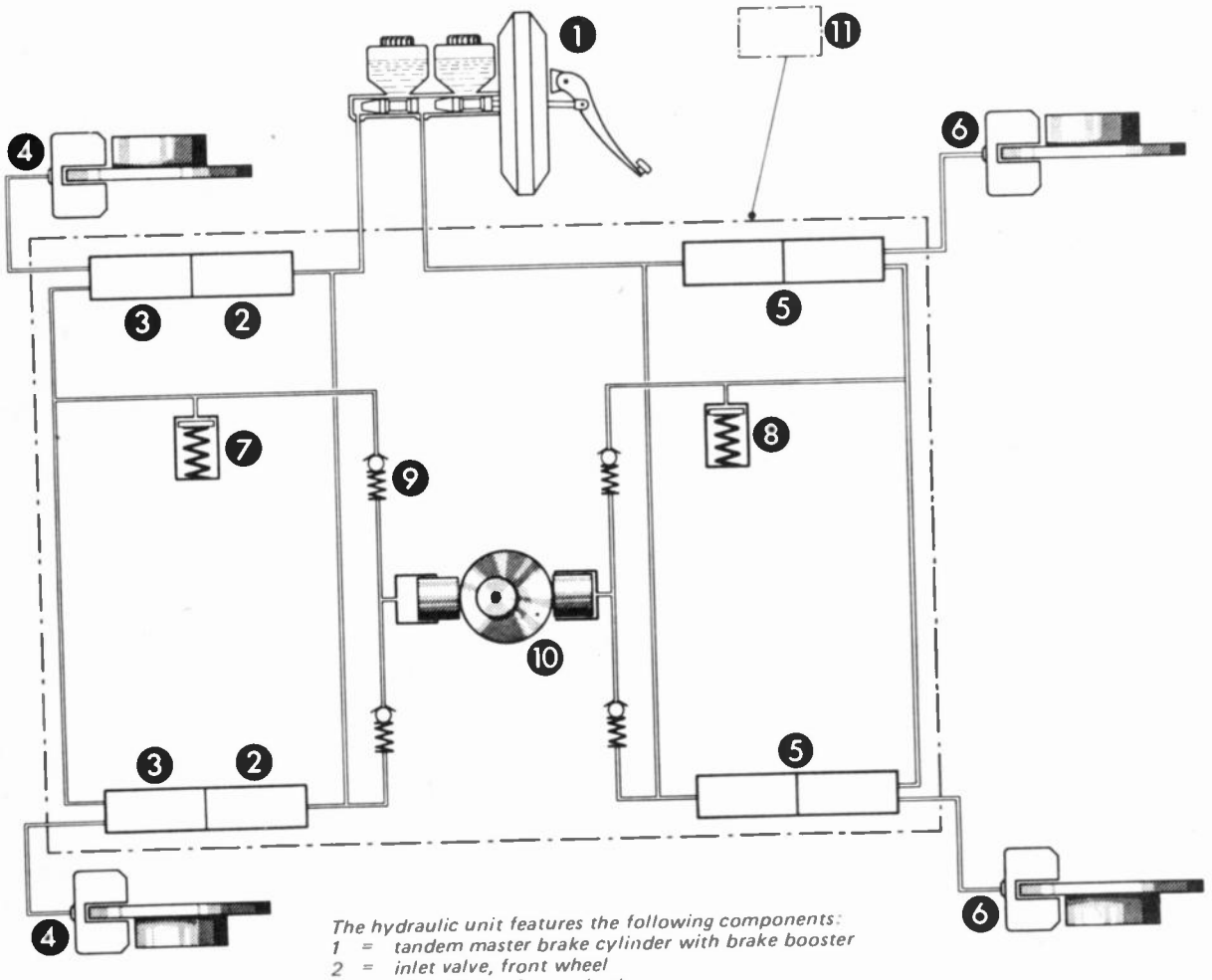
But this does not tell the whole story, for when braking, speed does not decrease in a linear progression; retardation increases towards the end of the stopping distance. At the point where the car equipped with the electronic system has stopped from 60 mph, the conventionally braked car would still be doing 25 mph.

On wet roads, the differences in stopping distances are even more dramatic. For example, on wet concrete a conventionally braked vehicle travelling at 90 mph recorded a stopping distance of 543 feet, whereas another vehicle, identical except for electronic braking control, stopped within 336 feet. At the point where the 'controlled' vehicle had stopped, the 'uncontrolled' vehicle's speed was still 53 mph.

More important still is the fact that with the automatic system the vehicle remains steerable – this is dramatically illustrated in our lead photographs where vehicles with the electronic system are seen maintaining their cornering line despite heavy braking, whilst conventionally braked vehicles have left the track.

It is greatly to Mercedes-Benz' credit that despite their very heavy development costs they have agreed to make the system available to other motor manufacturers. ●

FIG. 2 THE HYDRAULIC SYSTEM



The hydraulic unit features the following components:

1 = tandem master brake cylinder with brake booster
2 = inlet valve, front wheel
3 = outlet valve, front wheel
4 = caliper, front wheel (disk brake)
5 = valve set, rear wheel
6 = caliper, rear wheel (disk brake)
7 = brake fluid reservoir, front axle
8 = brake fluid reservoir, rear axle
9 = check valve
10 = dual-circuit floating-piston eccentric pump, driven by electric motor
11 = hydraulic unit

THE HARMON-KARDON CAD5 CASSETTE RECORDER

electronics TODAY product test

Although Harmon-Kardon is an American company, their new Dolbyized cassette recorder is built in Japan. Louis Challis reports . . .

The Harman Kardon cassette recorder is one of the smallest cassette recorders we have seen to date, even compared with the other Dolbyized casette recorders that we previously reviewed.

The external appearance is attractive. Imitation timber panelling is used on the top and front of the recorder, both side panels are timber with imitation edge strips, and the splayed control panel is finished in matt black. All controls are mounted on a splayed panel at the front of the recorder, with the exception of the two microphone inputs. These are located on the front panel. This panel has a rocker-type stereo-mono mode select switch at the left hand end adjacent to six small key switches. These key switches provide the following functions:—

a) record interlock
b) fast rewind
c) stop and cassette eject
d) play or record

e) fast forward
d) pause

Four small bezel indicators are mounted below the key switches. These indicate:—

a) record mode
b) drive motor 'on'
c) record level overload
d) Dolby 'on'

These are inadequately illuminated for medium to bright room conditions, with the exception of the overload light which was extremely bright when operative.

To the right of the key switches are dual VU meters, two slide-type record level potentionmeters, the Dolby "in" rocker switch and the power "on" rocker switch. The dual VU meter is clearly marked and easily read from a distance, although calibration is slightly inaccurate.

The cassettes are drop loaded onto the loading platform, which is raised by operating the "stop-cassette eject" key switch. The loading platform and cassette may then be pressed into the operating position without closing the smoked perspex dust cover. However, the manufacturers do recommend closing the dust cover to guarantee correct location of the cassette.

A small tape counter, which may be used for cueing, is located just behind the cassette well.

Four holes on the rear panel provide access to tab potentiometers so that the record and playback levels may be correctly adjusted before making Dolbyized tapes. The playback level potentiometers are normally preset in the factory and should not require further adjustment. In fact, if one does wish to check their setting it is necessary to obtain a Dolby level setting tape which is pre-recorded with a Dolby test tone of standard intensity. The record level potentiometers should be adjusted to provide optimum bias for each type or brand of recording tape, and the handbook explains how this should be done. A "hold-on" pushbutton is located on the back panel so that a Dolby test tone may be recorded on the desired brand of tape for adjusting the record level potentiometers. Adjacent to this pushbutton is a second push button for bias selection for chromium dioxide tape.

All inputs and outputs are effected via three pairs of R.C.A. coaxial sockets located on the rear panel. Two pairs of sockets are for inputs, one pair is for high level inputs (typically 600mV) and one pair is for low level inputs (typically 200mV). The third pair is for the output (950mV for 0VU output level).

For the subjective tests we recorded some of our favourite records on Advocate Crolyn CrO_2 and on BASF Low Noise cassettes and compared the recorded tapes with the original recordings in an A-B type test.

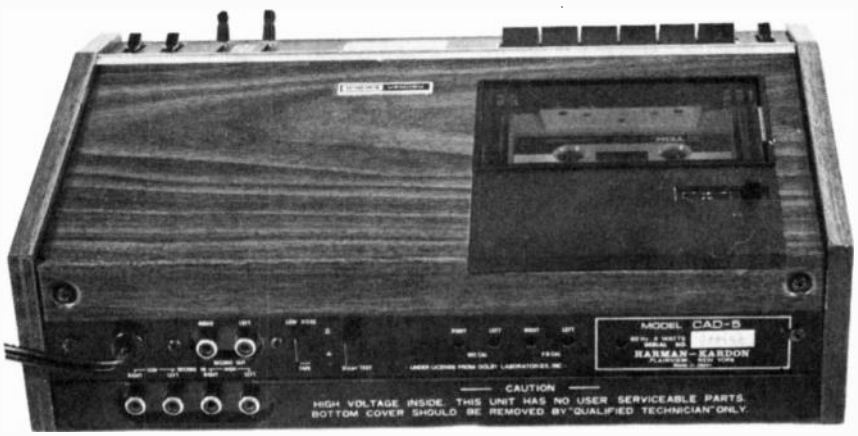
With the chromium dioxide tape the difference between it and the original was impossible to detect, except for a slight loss in the very high frequencies. (On many recordings there is negligible high frequency content above 12kHz and no difference would be discernible between an original and a recording on chromium dioxide tape). The loss is more apparent with the BASF Low Noise tape which on this recorder, rolls over at a frequency of approximately 10kHz. However, as many speaker systems roll over above 12kHz, the frequency response of the BASF tape will be more than adequate for most domestic hi-fi installations.

The measured performance confirmed our subjective appraisal. The record to replay frequency response extends to 13kHz with chromium dioxide tape. During the subjective and laboratory measurements we found the force required to operate the key switches rather excessive, particularly the record/replay switch. Admittedly we were continually changing from record to rewind to playback modes, which tended to accentuate the force required.

On a machine described by the makers as a *professional* stereo cassette, we expected to find a tape sensor of some form that would release the pinch roller and stop the drive motor when a tape fault occurred, but were dismayed when we realised that should a tape break, particularly during a recording session, the drive motor is kept operating and the only visible indication that a fault has occurred is that the feed hub has stopped rotating.

PRINTED CIRCUIT BOARDS

The electronic circuitry is contained on six printed-circuit boards. The main board, located under the cassette chamber, is fitted with three multipin plugs to facilitate removal for repairs.

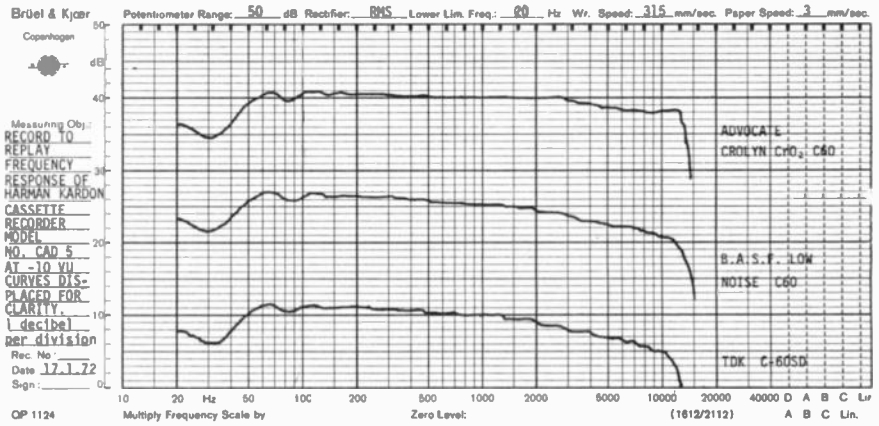


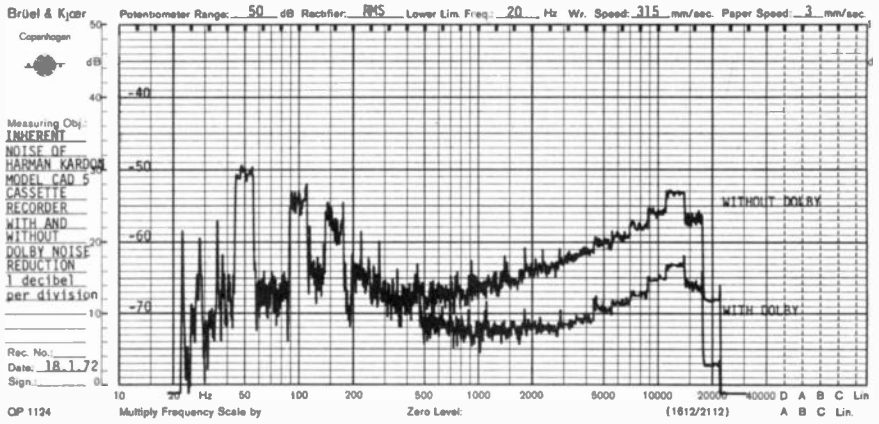
THE HARMON-KARDON CAD5 CASSETTE RECORDER

An intriguing, but excellent feature of the main printed circuit board is the addition of pieces of insulated wire approximately ½" long soldered to the various test points on the board. The free end of these wires are bared and looped so that alligator clips can be fixed to them for testing and adjustment purposes.

Another unusual feature of the circuitry is the 6 volt dc drive motor which eliminates the need to change drive pulleys for 50Hz or 60Hz operation and eliminates the high level of hum associated with dc motors.

The take-up spool sensor consists of a reed switch and a rotating magnet located under the tape counter. The mains transformer, which is mounted in a large compartment at the right hand end, is fitted with two primary windings which may be wired in parallel or series for 110V or 220V operation respectively. It would appear from the size of this compartment, and the use of a 6V dc motor, that the unit could be readily modified for battery operation. This would improve the signal to noise ratio (with Dolby) by as much as 10dB and would make the unit fully portable. A 12V battery wired in after the rectifier would appear to be the only modification required.





MEASURED PERFORMANCE OF HARMAN KARDON MODEL NO. CAD5

CASSETTE RECORDER (WITH DOLBY) SERIAL NO. 088669

RECORD TO REPLAY FREQUENCY RESPONSE:

	Record level 0VU	Record level -10VU
BASF low noise C60	40Hz to 5kHz $^{+2}_{-3}$dB	40Hz to 7kHz $^{+2}_{-3}$dB
TDK C-60SD	40Hz to 4kHz $^{+2}_{-3}$dB	40Hz to 6kHz $^{+2}_{-3}$dB
Advocate Crolyn C60	40Hz to 8kHz $^{+1}_{-3}$dB	40Hz to 13kHz $^{+1}_{-3}$dB

TOTAL HARMONIC DISTORTION RE 1kHz SIGNAL AT

	0VU	-10VU
	1.5%	0.4%

INTERMODULATION DISTORTION

	0VU	-10VU
Combined with signals of 1kHz & 960Hz	0.6%	0.4%

CROSS TALK AT 0VU

100Hz	36dB
1kHz	34dB
10kHz	30dB

SIGNAL TO NOISE RATIO RE 1kHz SIGNAL AT 0VU

Unweighted	= 46dB
Without Dolby (A scale) weighted	= 55dB
With Dolby (A scale) weighted	= 58dB

WOW AND FLUTTER 0.2% rms

SPEED ERROR, RECORD TO REPLAY Typically +0.4% to +0.8%

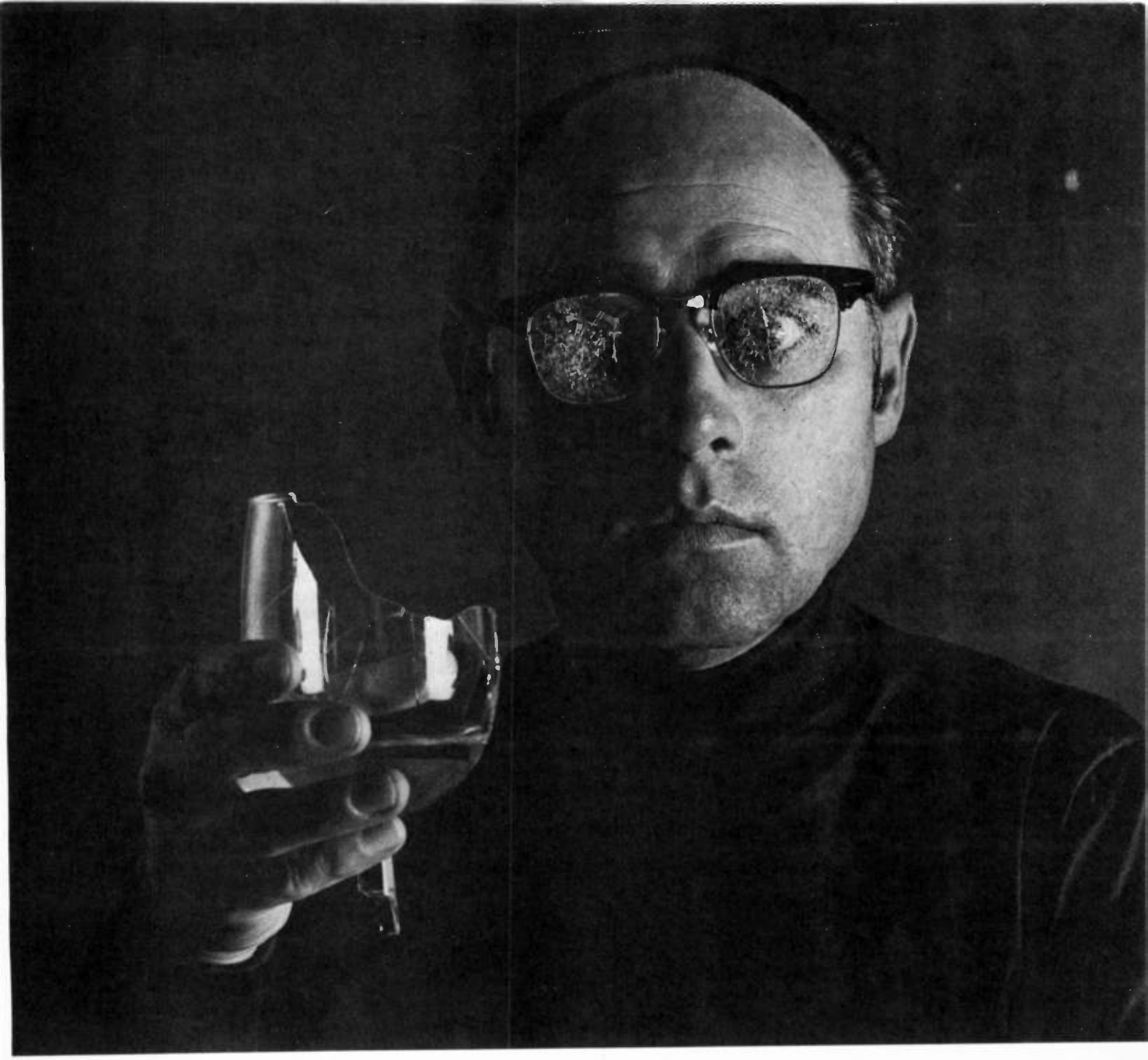
Dimensions 12½" wide x 9" deep x 3¼" high

Weight	10lbs.
Price – Recommended retail price	$319.

The unit was supplied with a complete set of RCA patchcords for record and replay. An 11" x 8½", 12 page Instruction Manual was also included. This very adequately describes the recorder's operations, but is inadequate in terms of maintenance instructions for fault finding. A circuit diagram is not supplied.

This recorder again highlights the advantages of incorporating the Dolby 'B' Noise Reduction system with a cassette recorder capable of utilizing the full capabilities of chromium dioxide tape.

This test report, graphs and measured specifications show that the Harmon Kardon recorder is a well-made unit with good performance. But it is a pity that the manufacturers describe it as a 'professional' unit. 'Professional' is a reasonably precise term and we feel that gimmicks such as this are out of keeping with the standards that we expect from *truly* professional equipment. But intending purchasers should appreciate that this is a criticism of the promotion rather than the unit itself. ●



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You get it all with AMPEX "Series 362" Extended Frequency Cassettes. Lower noise because of our super-smooth Ferrosheen ® tape. Higher output with exclusive small particle black oxide formula that produces more magnetic energy per square inch of tape. Provides response capability from 30-20,000Hz. And packaging to complement the finest equipment.

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AUDIO DISTORTION

oscilloscope aids analysis

Although no substitute for a distortion meter, an oscilloscope can measure frequency magnitude and phase of distortion components with reasonable accuracy.

Although the harmonic distortion meter and the intermodulation analyzer are *the* specialized instruments for measuring audio distortion, the oscilloscope can also be useful. A scope is particularly helpful in identifying the type(s) of distortion in various trouble situations. The scope may be used directly, or with a harmonic-distortion meter. Nearly all tests of hi-fi equipment place exacting requirements on scope characteristics, as will be explained.

SINE-WAVE DISPLAYS

Let's start with a review of sine-wave displays. Fig. 1 is the basic test setup. The load resistor should have a resistance roughly that of the rated amplifier output impedance and must also have a power rating at least equal to the maximum rated power output of the amplifier. Note that the audio oscillator must have a lower percentage distortion rating than the amplifier under test. Similarly, the vertical amplifier of the scope must have a lower distortion figure than the amplifier rating. Otherwise, the test results become meaningless — we will be measuring test-equipment deficiencies rather than amplifier performance.

Tests can be made at various levels of amplifier power output, but the most useful test is usually the one made at maximum rated power output. Most types of distortion show up most prominently at maximum output, although there are few exceptions. For example, crossover distortion is greater at *low* levels. Therefore, low-level performance must not be ignored.

Distortion must be appreciable before it becomes easy to see, when the method shown in Fig. 1 is employed. For example, Fig. 2 shows 1-kHz sine-wave patterns displayed when the output from the audio oscillator is fed directly into the vertical input terminals of the scope. Although high-quality instruments were used in this example, there is of course a slight amount of distortion. But even a highly experienced scope operator could not state the approximate percentage nor identify the types of distortion in the display.

A reference pattern like that of Fig. 2 should always be set up and observed before making measurements. Not only does it serve as a check on instrument condition, but it also establishes a standard for subsequent observations. Next, let us consider the pattern that is displayed when the 1-kHz sine-wave voltage is passed through an amplifier operating with 1% harmonic distortion. Fig. 3 shows the resulting pattern. Note that although this waveform contains 1% more distortion than the waveform illustrated in Fig. 2, it is very difficult to discern the difference.

When an amplifier operates at 2% harmonic distortion, the operator may be able to observe a departure from the reference pattern. For example, Fig. 4 is an example of 2% harmonic distortion. In this case, the distortion is caused by positive peak compression. This is one of the most common forms of audio distortion: it is caused by a nonlinear transfer

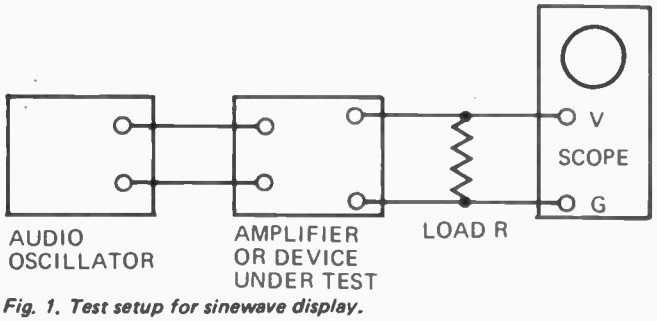


Fig. 1. Test setup for sinewave display.

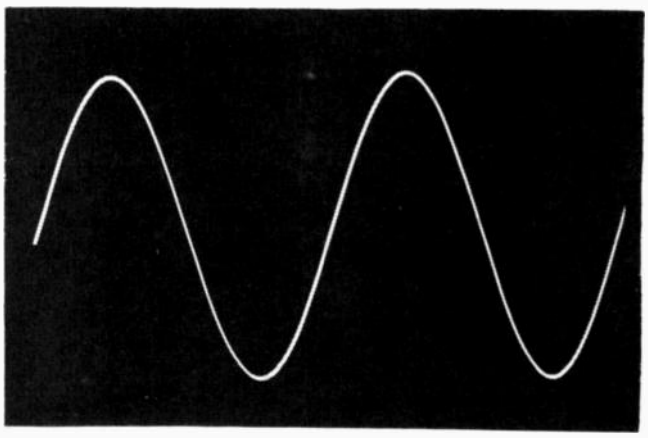


Fig. 2. Reference pattern produced by audio oscillator fed directly to oscilloscope.

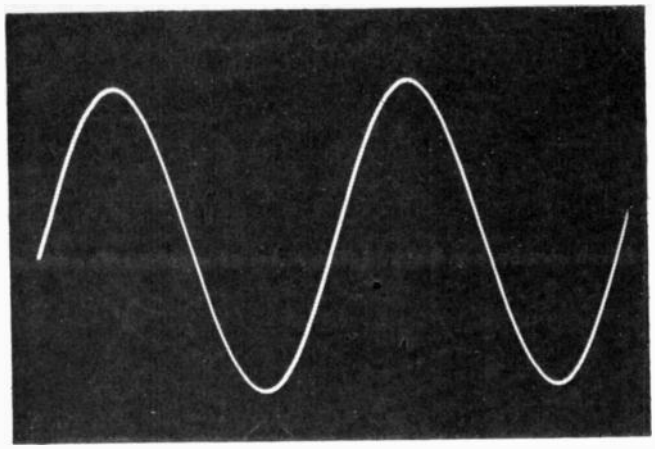


Fig. 3. This waveform has one percent more distortion than that shown in Fig. 2.

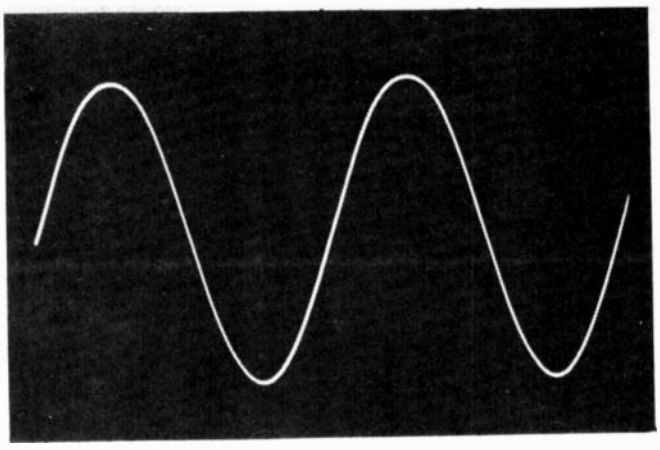


Fig. 4. Two percent distortion becomes noticeable.

characteristic, as depicted in Fig. 5. In this example, the bias point is incorrect. Note that even when the bias point is correct, overdriving inevitably results in double-peak compression or clipping, as shown in Fig. 6.

Higher percentages of distortion are progressively easier to observe in sine-wave patterns, as in Fig. 7. These are also examples of positive-peak compression. The relation of second-harmonic distortion to peak compression or clipping is depicted in Fig. 8. Introducing a second harmonic results in reducing one peak amplitude and increasing the other in the resultant complex waveform. (In general, we can state that assymmetrical distortion is caused by even-order harmonics, while symmetrical distortion is caused by odd-order harmonics.)

Although the ear has little or no discrimination for phase distortion, the resultant waveform of a fundamental and second harmonic, changes greatly with phase shift, and is very prominent in a scope pattern. As an example, if a second harmonic is introduced into a sine-wave with the phase shown in Fig. 9, peak compression does not occur. Instead, a mirror-image type of nonlinear distortion takes place. Note also that a harmonic-distortion meter is "like" the ear in that it has little or no response to harmonic phase relations.

LISSAJOUS DISPLAYS

It is easier to discern small percentages of distortion in scope patterns if we use Lissajous patterns. Fig. 10 shows the basic test setup. A linear time base is not used. Instead, the amplifier input waveform is fed into the vertical channel of the scope, and the amplifier output waveform is fed into the horizontal channel. Although the amplifier roles could be reversed, we usually have more amplifier output voltage than input voltage; and since the horizontal amplifier usually has less gain than the vertical amplifier, the arrangement shown in Fig. 10 is generally most practical.

Note that the audio oscillator need not meet hi-fi standards to be useful in Fig. 10. That is, the test setup is largely immune to distortion in the audio-oscillator output waveform. On the other hand, the scope must have low distortion vertical and horizontal amplifiers. Otherwise distortion in the scope will be charged against the amplifier under test in most cases. It is advisable to make a preliminary equipment check by omitting the amplifier in Fig. 10 and driving the scope's vertical and horizontal amplifiers directly from the audio oscillator. If the scope has low distortion amplifiers, a straight diagonal line will be displayed, as illustrated in Fig. 11-a.

Since no scope can be absolutely perfect, there is a slight amount of distortion in the pattern on Fig. 11-a, although it cannot be discerned. Next when an amplifier operating with 1% harmonic distortion is checked, we note that this amount of distortion is evident, although it might be overlooked by the inexperienced observer. Note in Fig. 11-b that if a straightedge is held against the displayed line, a definite curvature is apparent. This is also the case if we sight along the displayed line from end to end.

Although no industry standards have been established, it is generally agreed that high-fidelity reproduction entails a harmonic-distortion figure of less than 1%. Thus, the examples shown in Fig. 12 exceed high-fidelity limits. These tests were made at 1kHz, which is the standard single-test frequency. The particular curvature in the patterns is characteristic of peak distortion, and is essentially independent of the test frequency. Fig. 13 shows similar patterns for

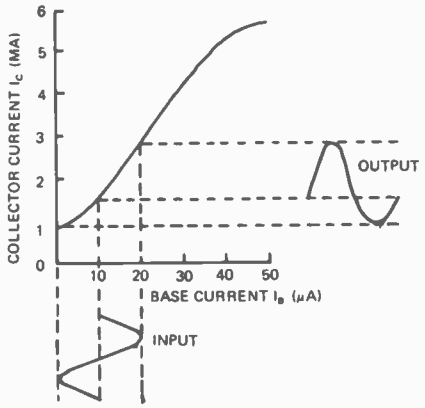


Fig. 5. Distortion due to incorrect bias.

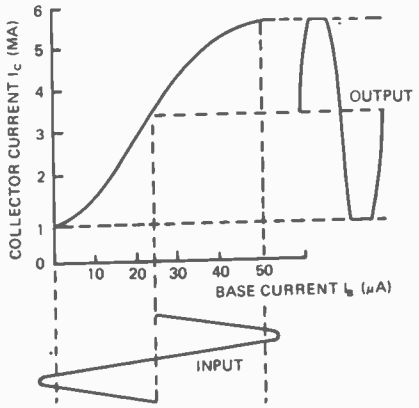


Fig. 6. Overdriving, even with correct bias, will cause distortion by clipping.

higher percentages of distortion. Note that the traces are visibly separated for the examples of 5% and 10% distortion. This is an indication of harmonic phase shift, in comparison to the foregoing photos.

Fig. 14 depicts the basic amplitude and phase-shift Lissajous patterns. We observe that clipping produces a sharp discontinuity in the pattern. All ac-coupled audio amplifiers shift phase in the vicinity of their high-frequency and low-frequency cutoff points. A dc-coupled audio amplifier exhibits

AUDIO DISTORTION-

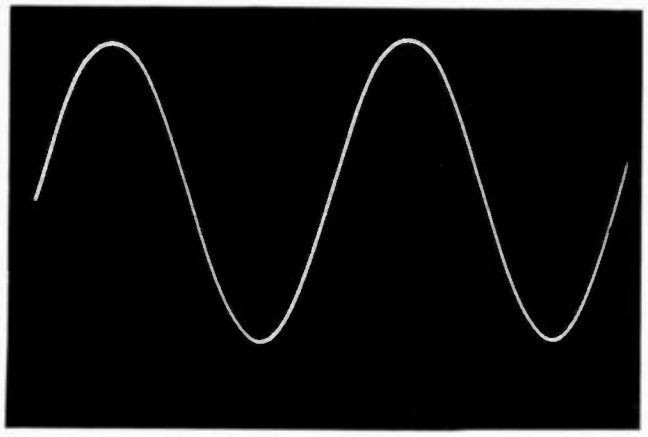


Fig. 7a

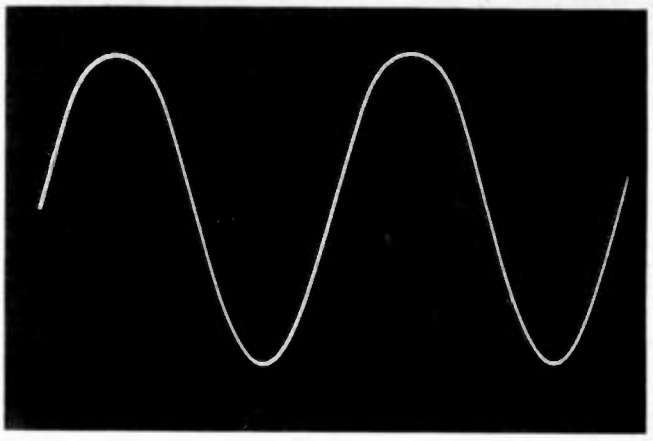


Fig. 7b

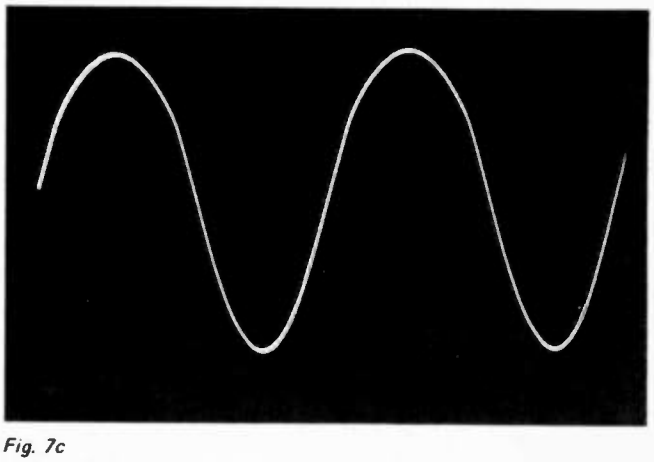


Fig. 7c

Fig. 7. Positive peak compression (a) 3% harmonic distortion (b) 5% (c) 10%.

phase shift only in the vicinity of its high-frequency cutoff point, since its low-frequency cutoff point is zero Hz. As noted previously, the percentage of harmonic distortion due to crossover distortion increases as the output power is reduced.

ANALYSIS OF DISTORTION PRODUCTS

An oscilloscope is also useful for checking harmonic-distortion products, as shown in Fig. 15. This application is least demanding on scope performance, and any service-type scope can be utilized. When the harmonic-distortion meter is adjusted to reject the test frequency (such as 1kHz), the scope then displays the waveform of the distortion products. This is very seldom a second harmonic alone, a third harmonic alone, or a mixture solely of second and third harmonics. In most situations, we will find a distortion waveform that consists of a number of even and odd harmonics. However, one harmonic, such as the second or the third harmonic, is usually dominant. This can be determined by using the scope to measure the frequency of the complex distortion waveform.

Frequency can be measured easily if the scope has calibrated sweeps. For example, if the test frequency is 1kHz, and the period of the distortion waveform is 500 μs, we know that the dominant distortion product is the second harmonic. On the other hand, if the scope does not have calibrated sweeps, a simple comparison test will determine the period of the distortion waveform. The scope is adjusted to display one complete cycle when the harmonic-distortion meter is set to feed the input waveform through. Then, when the harmonic-distortion meter is adjusted to reject the test frequency, we observe how many cycles of the distortion waveform are displayed on the scope screen. For example, if three cycles are displayed, we know that the dominant distortion product is the third harmonic.

Note that phase relations are not troublesome in most cases. For example, Fig. 16 depicts a distortion waveform made up of a dominant second harmonic with a subordinate sixth harmonic. In these two examples, the sixth harmonic has zero phase and 180° phase respectively, with respect to the second harmonic. However, the number of zero crossovers remains the same, and the

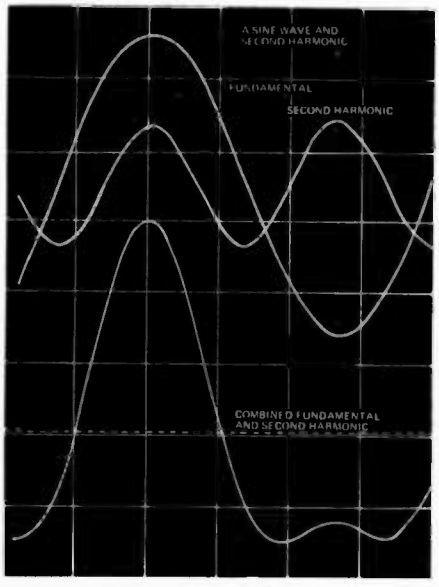


Fig. 8. Second harmonic distortion and its relation to peak compression or clipping.

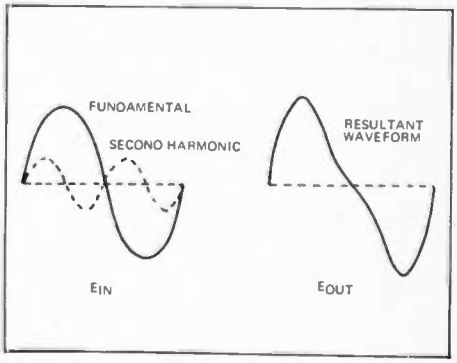


Fig. 9. Mirror image distortion due to phase of second harmonic insertion.

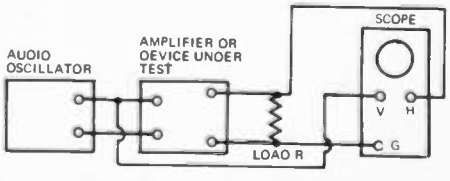


Fig. 10. Lissajous displays can be obtained with the test set-up as shown.

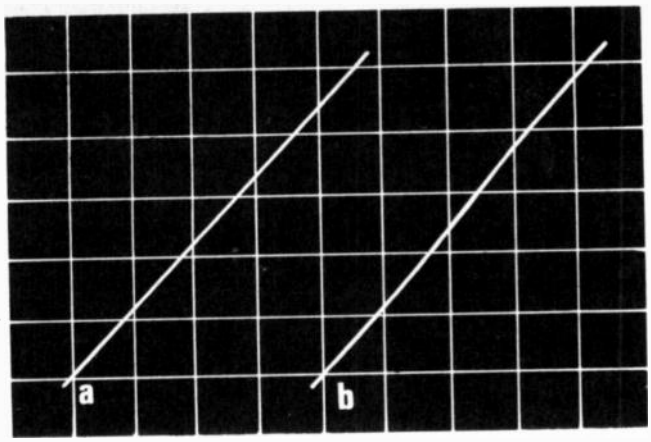


Fig. 11. Lissajous display of amplifier output. (a) negligible; (b) 1% distortion.

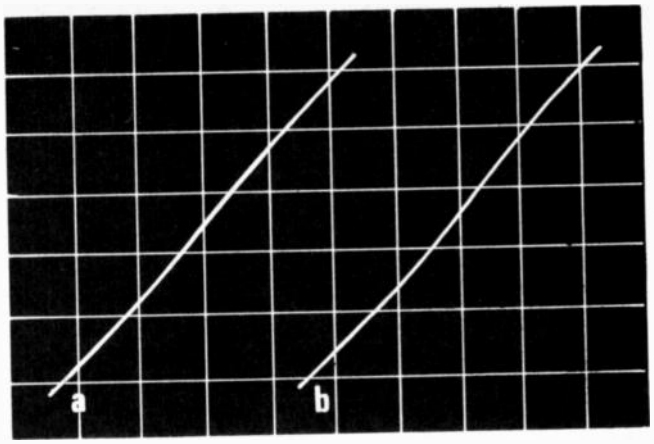


Fig. 12. Increasing distortion is easy to see (a) 1.5%, (b) 2% distortion.

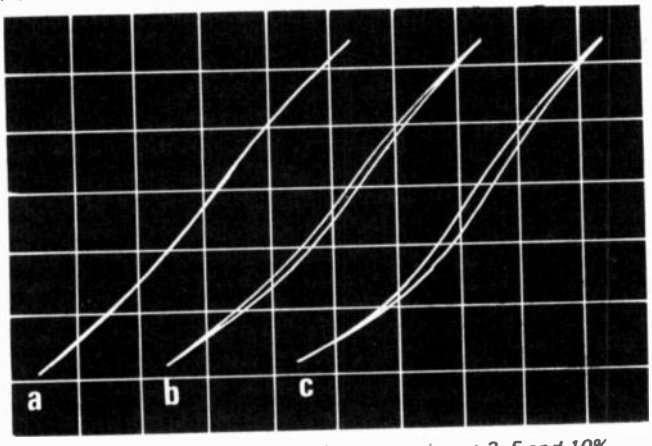


Fig. 13. Lissajous patterns for peak compression at 3, 5 and 10% harmonic distortion.

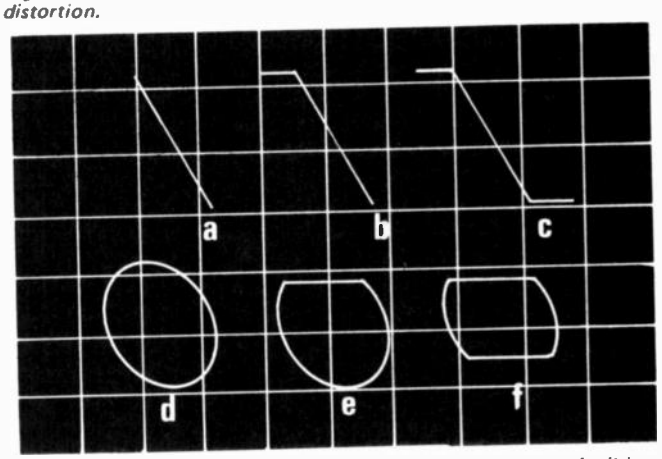


Fig. 14. Classic audio patterns. (a) no overload, no phase shift; (b) peak clipping, no phase shift; (c) double peak clipping, no phase shift; (d) phase shift no amplitude distortion; (e) phase shift and peak clipping; (f) phase shift and double peak clipping.

period of the complex distortion waveform is unchanged.

Finally, we may note that apparent harmonic distortion might be hum distortion in the whole or in part. In either case, scope analysis of the distortion waveform will quickly show whether 50-Hz or 100-Hz hum voltage may be present.

CONCLUSION

Although the harmonic-distortion meter is the basic instrument for measurement of audio distortion, the oscilloscope is a useful supplementary instrument. When an harmonic distortion meter is not available, a scope can be used for qualitative and even for rough quantitative analysis of distortion. The most useful approach is to display in input-output Lissajous pattern. To obtain meaningful results, both the vertical and the horizontal amplifiers of the scope should have low distortion. A scope is also useful for checking harmonic-distortion products in audio circuits when used with an harmonic-distortion meter. ●

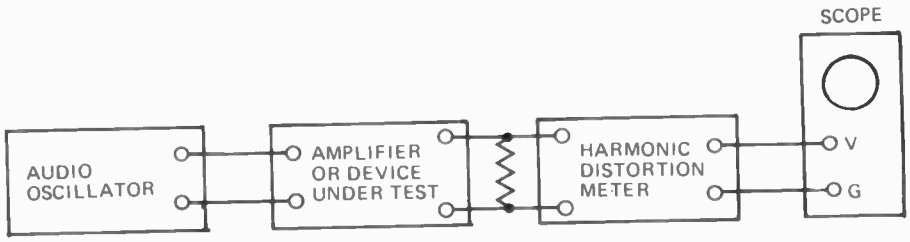


Fig. 15. Harmonic distortion test setup for analysing distortion products.

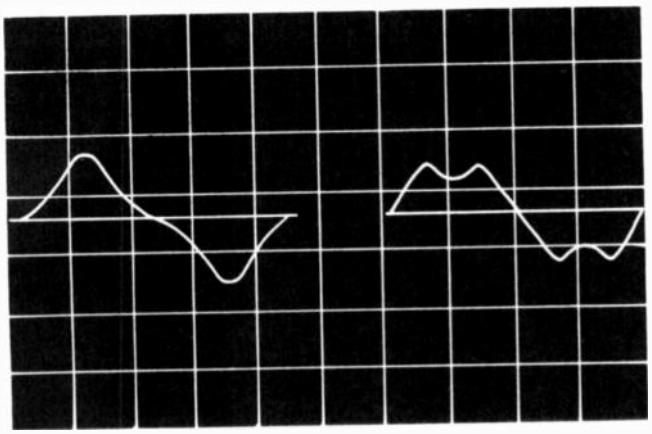
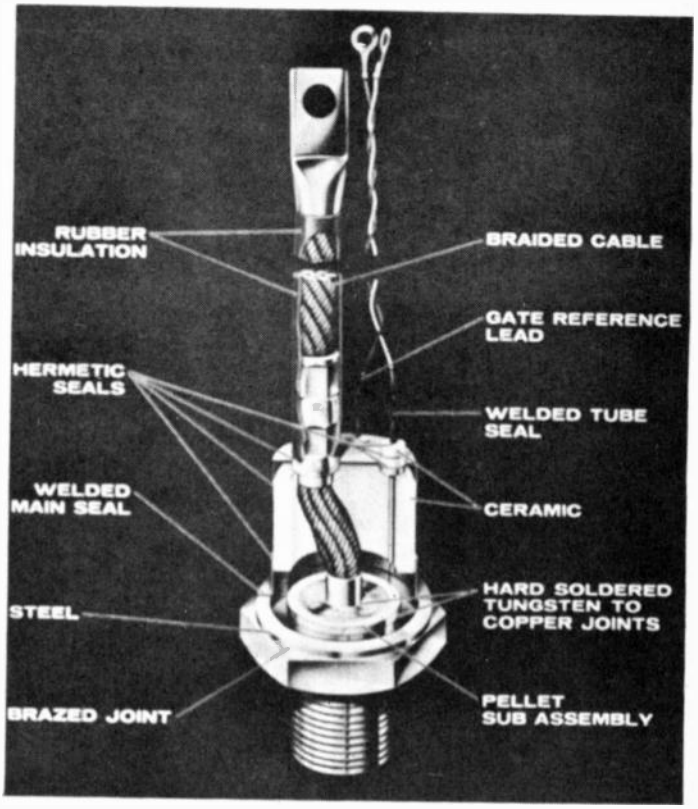


Fig. 16. These two distortion waveforms are alike except for relative phase relations.

Reprinted by arrangement with Radio Electronics, February 1972.

A PRACTICAL GUIDE TO SCR's

Used in applications as diverse as switching 240 volts in a photographic timer to forming a major element in a 50,000 hp motor speed control system — the SCR is a simple device with a myriad of uses. Here, Collyn Rivers explains, simply and clearly, how to use this versatile circuit component.



THE silicon controlled rectifier (or SCR as it is commonly called) is a rectifying device in as much that it can be *caused* to have a low resistance in the forward direction, but *always* has a high resistance in the reverse direction.

The device is called a silicon *controlled* rectifier since it can be switched from a very high forward resistance (its 'off-state') to a low forward resistance (its 'on-state'). And although silicon controlled rectifiers can cope with both high voltage and high current, they can be switched from the 'off-state' to the 'on-state' with very low levels of gate voltage, current and power.

Silicon controlled rectifiers are readily available in a wide variety of shapes, sizes and power handling capabilities. They may be encapsulated in plastic, encased in metal, and either air or water cooled. Voltage capabilities range from 12 volts to many thousands of volts, and current ratings from a few milliamps to several thousand amps. SCRs are surprisingly cheap, for example GE's C 106 (4 amps) can be bought in quantity for less than fifty cents.

They are, in many respects, a solid-state equivalent of the gas-filled thyratron, and like the thyratron, once triggered into the 'on-state', SCRs can only be switched off again by breaking (or reversing) the flow of current through them.

The circuit symbol and schematic diagram of the silicon controlled rectifier is shown in Fig. 1.

THE SCR IN AC CIRCUITS

In ac circuits, the polarity of the voltage across the SCR is reversed on alternate half-cycles, and the resultant reverse voltage will cause the device to revert to the 'off-state', switching on again during the next positive half-cycle only if a triggering voltage exists at the gate. When used in this fashion, conduction may be initiated at the beginning of any positive half-cycle, thus providing a simple on-off control. Or conduction may be initiated at some later time in the positive half-cycle, thus varying the voltage impressed upon the load. This process is known as 'phase-control'.

Silicon controlled rectifiers may be used to control ac power by connecting them in inverse parallel so that one SCR conducts load current in one direction, while a second conducts in the opposite direction. The gate firing signal may be used to switch on the flow of current, and by using phase control, the average power applied to the load may be varied.

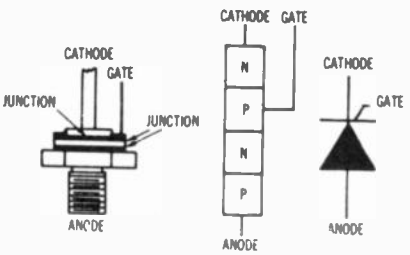


Fig. 1. Cross Section, Block Diagram, and Electrical Symbol of Silicon Controlled Rectifier.

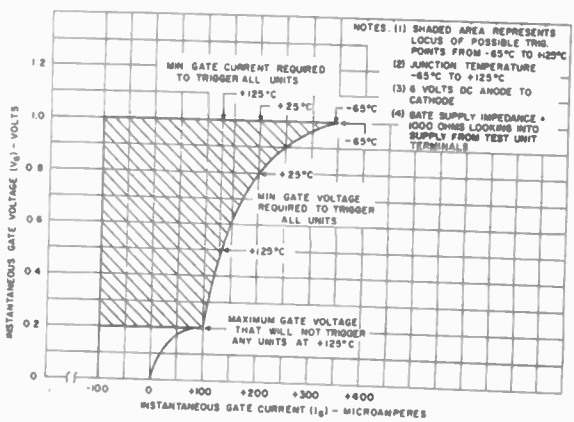


Fig. 2. This graph shows the triggering characteristics of the low-current type C106 SCR.

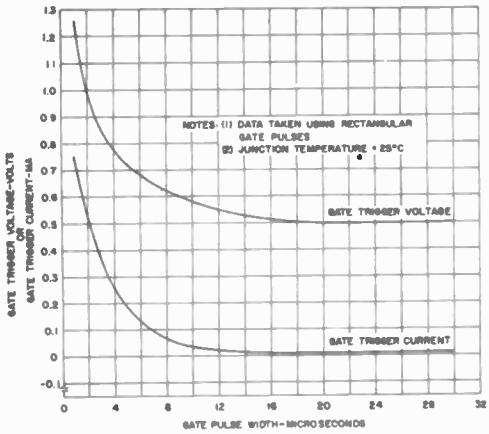


Fig. 3. Relationship between trigger pulse width and pulse magnitude (C106 SCR).

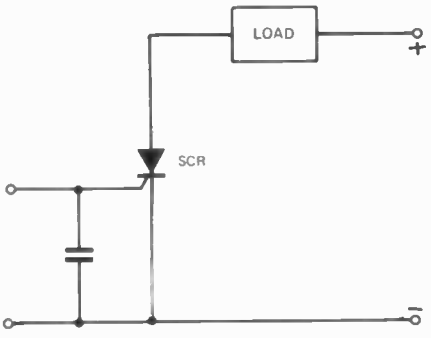


Fig. 5. Where dc triggering is used, a capacitor may be used in place of a bias resistor.

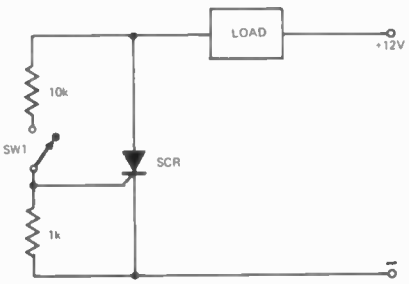


Fig. 6. Basic SCR switching circuit.

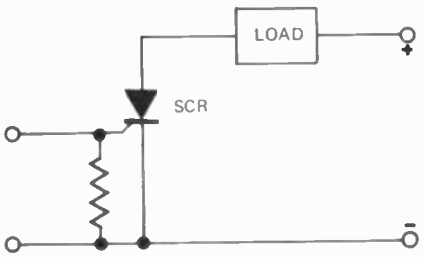


Fig. 4. A 1k bias resistor is connected between gate and cathode to provide operational stability.

THE SCR IN DC CIRCUITS

In dc circuits, where the voltage across the SCR does not reverse, the gate may be used to initiate current flow, but some specific means must be used to turn the SCR off again. This may take the form of a mechanical switch that interrupts the load current, or a more complex circuit in which firing a second SCR causes a break in load current or a momentary flow of reverse current through the first controlled rectifier, causing it to turn off. This latter process is called commutation and is the basis of operation of the SCR inverter.

TRIGGERING THE SCR

A silicon controlled rectifier is triggered into conduction by a positive pulse (or continuous dc voltage) applied to its gate terminal.

The level of voltage required varies from one type of SCR to another — and between individual SCRs of the same type. It is also affected by ambient temperature (voltage and current firing requirements decrease as temperature increases).

typical graph — showing firing requirements of the C106 series is shown in Fig. 2.

Manufacturers of SCRs publish specification sheets showing firing requirements in graphical form. A

The graph also shows the maximum gate voltage that will *not* trigger a C106. This knowledge is invaluable in applications where a small constant voltage may be impressed on the gate.

The graph shown in Fig. 2, and its counterparts for other SCRs, applies only when the SCR is being triggered from a dc gate source, or from a pulse source where the pulses are of relatively long duration. But if the width of the trigger pulse is reduced below about 20 micro-seconds, it is necessary to increase the magnitude of the triggering pulse above that shown for constant voltage triggering (in Fig. 2 etc.). The relationship between trigger pulse width and magnitude for the C106 is shown in Fig. 3.

BIASING

Many low-current SCRs are so sensitive that they require only a few micro-amps of gate current for reliable triggering. In fact, at high temperature, or with high voltage applied, the SCR's internal leakage may be sufficient to cause self-triggering. Similarly, in high frequency ac applications, or in dc circuits where anode voltage is suddenly applied, sufficient capacitive current may flow to trigger the SCR. In all applications where low-current SCRs are used, the possibility of spurious triggering must be eliminated by the provision of sufficient stabilizing gate bias.

In most applications the necessary gate bias can be readily obtained by connecting a resistor (of about 1k) between the gate and the cathode — as shown in Fig. 4. A bias resistor — *as such* is not always required, for in dc coupled gate circuits the output resistance of the trigger source (pulse transformer — or UJT base one resistor) will serve the same purpose. Again in many circuits where dc triggering is used, a capacitor may be used in place of the bias resistor (the optimum size will be somewhere between 0.1uf and 0.5uF.) Fig. 5 refers.

Generally it can be said that the stability of SCR circuits increases almost in proportion with decreasing bias resistance and that the maximum amount of bias (minimum resistance) should be used commensurate with the available triggering source. The lower limit of bias resistance is reached when the trigger source can only just supply sufficient current for the parallel combination of SCR gate and bias resistance.

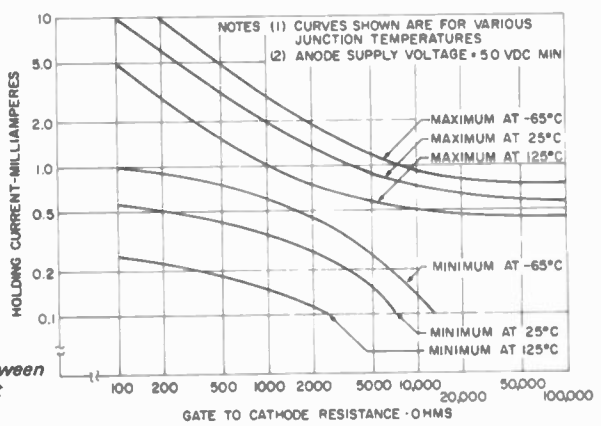


Fig. 7. Relationship between bias and holding current (C106).

A PRACTICAL GUIDE TO SCR's

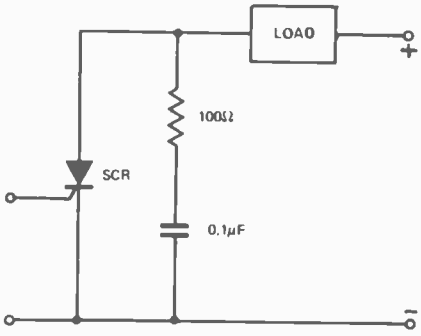


Fig. 8. Resistor/capacitor combination connected across the SCR provides dv/dt suppression (see main text).

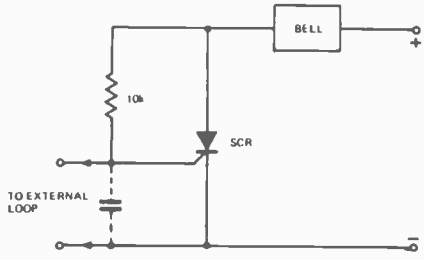


Fig. 9. This basic alarm circuit is in common use, but is prone to false triggering – see main text.

LATCHING

A basic SCR switching circuit is shown in Fig. 6. In this circuit the SCR is in series with the load. The SCR is normally non-conducting (i.e. no power is applied to the load), but if a positive potential is applied to its gate – for example by closing SW1 – the SCR will be switched on and the load energized. The SCR will then remain switched on, even if SW1 is subsequently reopened. This action is called 'latching'.

A certain minimum current must pass through the SCR for the device to switch to the 'on' state and to remain in the 'on' state (latched) after the cessation of a gate triggering pulse. But once latched, a somewhat lower level of current will suffice to prevent the SCR reverting to the 'off' state. This latter current level is called the 'holding' current.

The level of latching and holding currents vary from one type of SCR to another – and indeed between different SCRs of the same type. The current levels are also dependent upon ambient temperature and the value of the gate bias resistor. (Typical figures for the C106 range, at 25°C, are – holding current, 3.0 mA; latching current, 4.0 mA.)

The use of resistive bias also affects the level of latching and holding current required. The greater the amount of bias the higher the current required for reliable holding. Figure 7 shows the relationship between bias and holding current for a typical 4 amp SCR.

(Some difficulty may be experienced in obtaining reliable latching in circuits where the load is primarily inductive, as for example with relay coils, even though the steady state current exceeds the latching requirements. Here the remedy is to connect an appropriate resistor across the inductive load. The resistor should be selected to ensure that it alone can pass enough current to effect latching.)

FALSE TRIGGERING

In some SCR circuits the SCR will tend to 'switch on' the moment the dc supply voltage is applied, at the SCR's gate. This is because the SCR is sensitive to the rate at which the supply voltage is applied, and if this rate of rise exceeds a certain level, switch-on will occur. The effect may be eliminated by connecting a series resistor/capacitor combination across the SCR. This is known as dv/dt suppression and its effect is to slow down the rate of voltage rise. A diode, connected in the same effective polarity as the SCR, may be paralleled across the resistor for maximum effectiveness. In most applications the values shown in Fig. 8 will prove effective.

False triggering can also be caused by transients induced into the gate circuits. This is a very common problem with a number of burglar alarms – even commercially made ones from manufacturers who should know better.

The most commonly used SCR burglar alarm circuit is basically that shown in Fig. 9. In this configuration, the gate of the SCR is connected to the positive rail via a 10k resistor, but an external loop interconnecting a number of normally closed trip switches, effectively clamps the gate at zero potential. However if any switch is opened, or if the external loop is cut, the SCR will immediately be triggered into conduction, thus energizing a series connected bell.

The problem with this circuit is that although the gate of the SCR appears to be held very firmly at zero potential by the external loop, transient energy induced into the external loop by electro-magnetic phenomena (caused by lightning, arc welders, fluorescent lighting starters etc) can reach quite high voltage levels at the 'open' SCR end of the loop. And these levels are more than sufficient to trigger a sensitive SCR.

In some instances this type of false triggering can be overcome by connecting a 1.0uF capacitor between the SCR's gate and cathode but generally speaking it is bad practise to connect long 'aerials' directly to the gate circuit of an SCR.

A better solution is to use a UJT as a 'buffer stage' – as shown in Fig. 10. This will ensure that the gate circuit is totally immune from false triggering no matter how long the external circuit, (UJT and other triggering circuits will be described in greater detail in the second article in this series).

False triggering may also be caused by switching transients if long external leads are used in the anode or cathode circuit of the SCR. This sometimes occurs with burglar alarms and other control and warning systems if a bell (or other load) is located some distance away from the SCR.

This problem can almost invariably be overcome by using dv/dt suppression (as shown in Fig. 8). In extreme cases it may be necessary to use a 5uF capacitor and a 5k series resistor, but values of 1uf and 1k will generally suffice.

STATIC SWITCHING CIRCUITS

As may be seen from the examples shown so far, the SCR in a dc circuit is analogous to a static latching switch, making it an ideal replacement for relays, contactors, and other electromechanical devices. Where latching action is undesirable, latching may be eliminated by driving the SCR from an ac supply. In either case the SCR doubles as a power switch with all the advantages of a solid state component – small size, high speed, ruggedness and long life – and as a high gain amplifier.

The second part of this series – to be published next month – shows how SCRs are used in logic systems, and describes how phase control systems operate. Many practical circuits will be included. ●

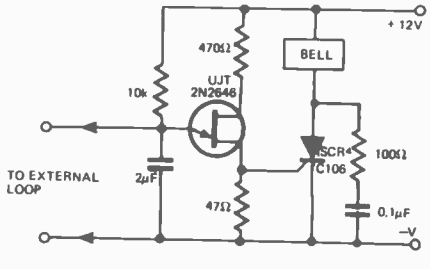


Fig. 10. This is a greatly improved version of the circuit shown in Fig. 9. The addition of the 2N2646 UJT effectively isolates the gate of the SCR from signal transients.

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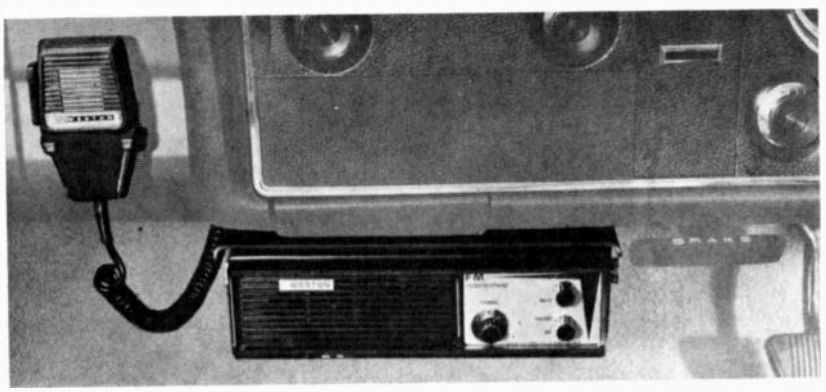

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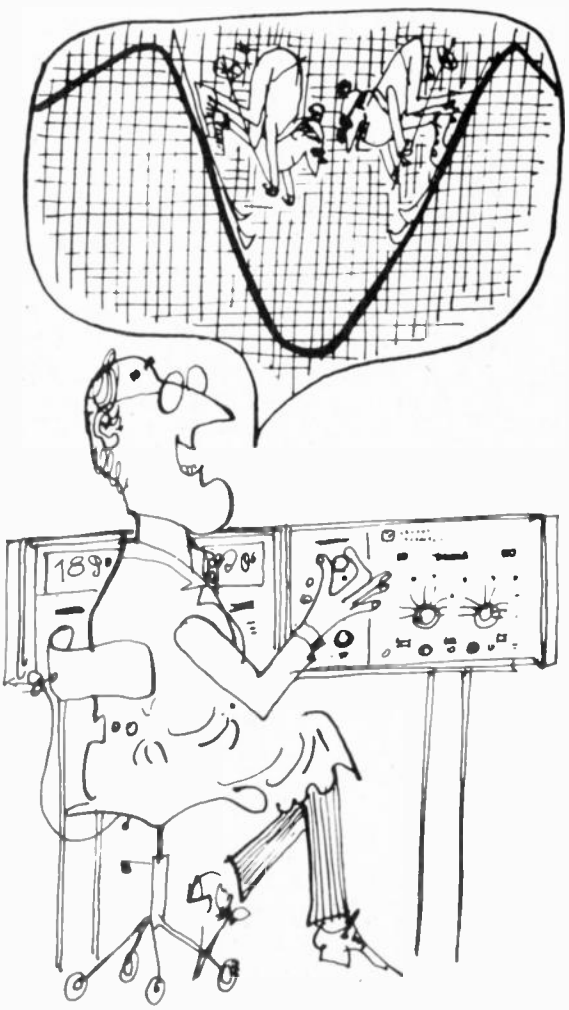

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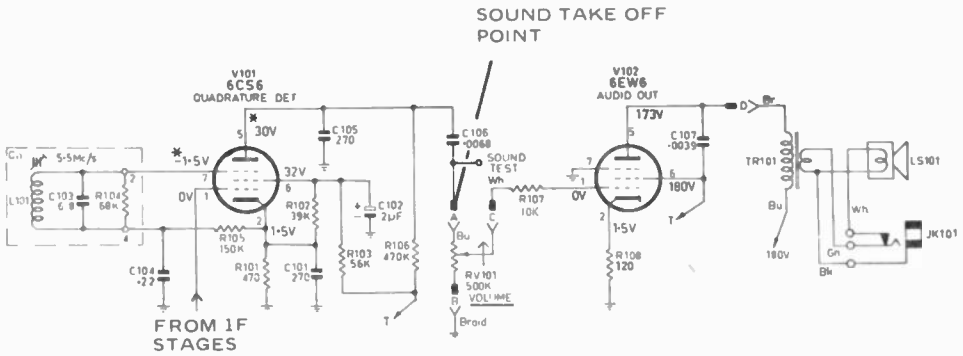


Fig. 1. Typical T.V. detector and audio amplifier showing recommended take off point.

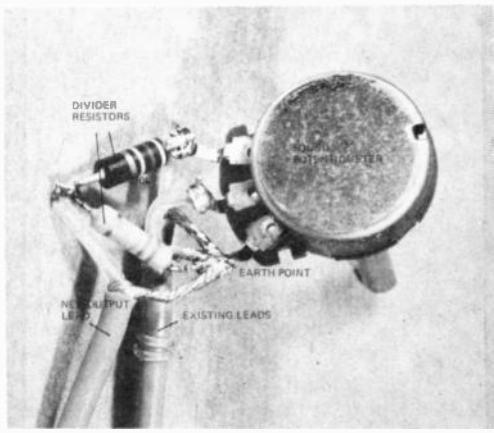


FIG. 2. This picture shows method of incorporating divider at volume control.

INHERENTLY, FM is a good way to transmit high fidelity sound.

Unlike AM, the modulation bandwidth is not unduly restricted and the full 30Hz-15kHz audio range can readily be transmitted; and as a limiting amplifier is used just prior to the detector, all spurious amplitude modulation, whether from atmospheric noise, hum or frame buzz, is removed. The signal at this point, is therefore, a clean, faithful reproduction of the full dynamic range of the original programme material.

But from here on the average manufacturer of commercial TV receivers does the audio signal somewhat less than justice, and the resultant sound from the loudspeaker is a mere travesty of what it could otherwise be.

The argument used to justify this acoustic villainy is one of technical and economic expediency.

To achieve volume sales, the selling price of most TV sets has been held at an unrealistically low level. In fact – ignoring the very real decrease in the value of money over the past few years – the *actual* monetary price of TV sets has fallen. Inevitably some performance compromises have to be made – and whilst today's TV receiver is very good value for money – if its selling price were to be 50% higher, one would have a far, far better set.

From the hi-fi enthusiast's point of view the only really significant circuit compromises are those affecting sound reproduction. And it is in this part of the receiver that a number of compromises are made.

The most serious of these is lack of really adequate filtering and decoupling of the HT supply rail – and as a consequence, hum and frame buzz is introduced into the audio amplifier.

To prevent this being reproduced by the speaker, manufacturers limit the low frequency response of the audio amplifier to not much less than 100 Hz. Tonal balance is then regained by tailoring the high frequency response; decreasing below 3kHz or so (and falling to some 10 or 12 dB down at 10 kHz). This droop also eliminates any beat notes formed with the line time base frequency.

So we are left with an amplifier having an effective response of 100 Hz to 3 or 4 kHz, a power output of somewhere between 1 and 3 Watts and a total harmonic distortion somewhere between 1½ and 6%. By now it is of little consequence that the signal is finally reproduced via a speaker that may be less than 3" in diameter (rarely larger than 6" x 9") and of distinctly mass-production quality.

But as 98% of the population listens to 'music' through the 2" speakers normally fitted to small transistor-radios, a typical TV receiver sounds at least one order of magnitude better anyway.

Some, but relatively few, de luxe TV receivers have good quality amplifer/speaker combinations, but even these seldom approach true high fidelity standards.

But for those who care about decent sound reproduction – there is a way out.

This involves taking the television sound signal directly from the detector and feeding it to the 'radio' or auxiliary input of a hi-fi system. In this way the high quality programme material can be reproduced at full hi-fi standard.

One apparent drawback is that the sound source may now be some distance away from the TV screen. This is not as serious an objection as it might at first seem, for the mind makes a spatial adjustment, and after a few minutes one does not notice that the sound and the vision sources are really separated.

Technically, the modifications required to extract the sound signal are simple, but several very important points must be borne in mind, for very high voltages are used in TV sets (and we like to keep our readers).

Firstly, although this may seem absolutely elementary, not only switch off the receiver, but also REMOVE THE POWER PLUG from the wall outlet, BEFORE removing the back of the set.

Secondly, when the back of the cabinet has been removed, spend some time familiarising yourself with the layout of the components *before touching anything.*

The picture tube, by far the largest

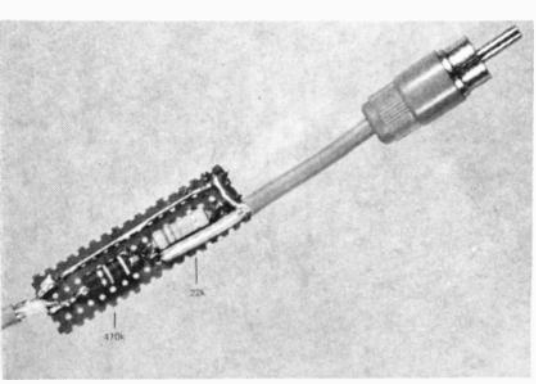


Fig. 3. Attenuator fitted at amplifier end of connection cable.

TV SOUND

TV sound quality is inherent. This simple modification allows you to obtain it.

PROJECT 409

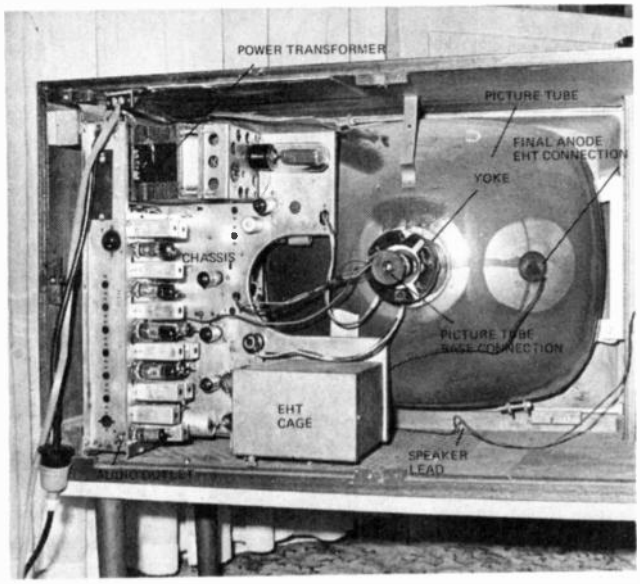


Fig. 4. Rear view of typical receiver chassis shows location of major components.

component, has the deflection yoke mounted round the neck of the electron gun assembly.

A connector at the end of the neck brings filament and other electrode voltages into the gun. The final anode of the picture tube operates at 18 to 20kV and a single lead conducts this voltage through the side of the picture tube glass wall.

Treat this connection with the greatest of respect. The final anode, the glass wall of the picture tube and the outer eathed coating form a capacitor which charges to the full 20KV. This capacitor will remain charged sometimes for several days after power has been disconnected and can deliver quite a nasty shock. It is wise to earth the final anode (with a well insulated lead) before trying to disconnect the supply lead.

MODIFICATIONS REQUIRED

To perform the modification; access must be gained to the volume control which is usually located on the cabinet front.

Most recent TV receivers have chassis which either swing down or to one side for service, and it would be unlikely that these chassis would have to be removed. However, some older sets have pan type chassis which must be withdrawn to gain access to the volume control.

Should chassis withdrawal be necessary, remove all the front panel control knobs, chassis retaining screws and make absolutely sure that all the following leads are disconnected.

1) Antenna lead
2) Picture tube EHT lead (discharge first as above).
3) Picture tube base connection
4) Yoke leads
5) Speaker leads

Failure to disconnect these leads could result in damage either to the connectors or to the picture tube.

The required audio signal can be taken from either the slider, or the top, of the volume control potentiometer. If it is taken from the slider, the overall volume can still be controlled from the normal TV receiver volume control, but the TV audio amplifier will still introduce distortion. If the signal is taken from the top of the volume control potentiometer this distortion is avoided, but the TV sound must now be controlled by the hi-fi amplifier's volume control. An additional, although not serious problem is that the level of audio signal at this point is usually five volts or so, and this must be attenuated to the 100mV to 200mV required by most amplifiers.

Despite these difficulties, this second method of extracting the required signal is the more satisfactory.

The required attenuator – consisting of a 470k and a 22k resistor (both ½ Watt 10% tolerance) may be either wired across the existing volume control potentiometer as shown in Fig. 2, or incorporated within the connection plug at the amplifier as shown in Fig. 3.

A short length of screened cable is then taken from the signal take-off point to a socket mounted on the rear of the chassis (or cabinet). The screened lead must be insulated. It should be routed and tied in position to ensure that it does not contact any high voltage components. A further external, screened lead must be used to connect the TV receiver to the hi-fi amplifier.

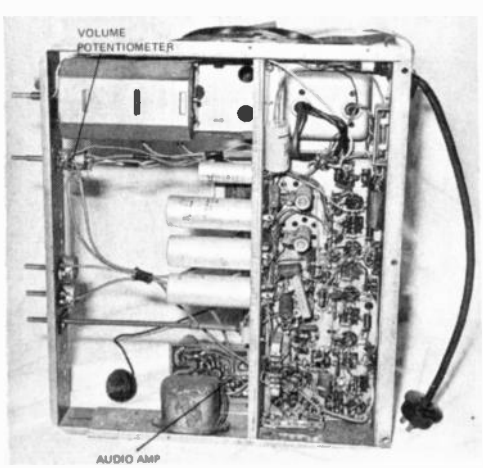
If the attenuator resistors are mounted within the receiver, keep the resistor leads and any unscreened wires as short as possible, otherwise inductive pick-up at line frequency will introduce an unpleasant beat effect.

IMPORTANT

Some imported receivers and a few older receivers have no power transformer.

In these sets, the valve filaments are operated in a series chain and one side of the mains input is connected to the chassis. If the mains input 'active' and 'neutral' are reversed, the chassis will be live.

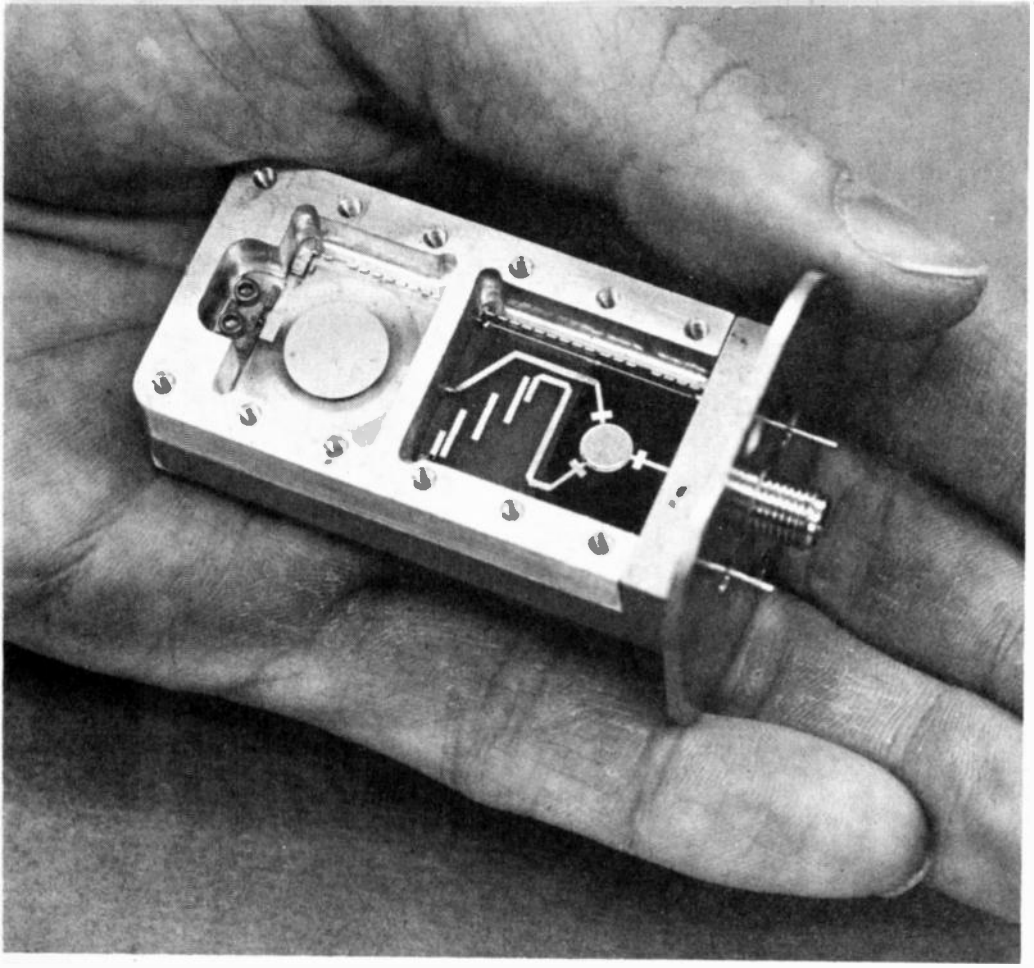
Because of this the modifications suggested in this article should not be attempted unless an isolating transformer is used.



Where dual volume/brightness controls are used, the correct potentiometer section may be determined in the following manner.

The *larger* of the two knobs always drives the *outer* shaft. The outer shaft always drives the potentiometer section closest to the knobs, and the inner shaft (small knob) always drives the rear section. Thus inspection of the assembly will quickly reveal which is the correct potentiometer. ●

Fig. 5. Typical chassis showing combined VOL/BRILL/ON-OFF control.



DOPPLER RADAR MODULES

This low cost solid-state module detects motion using microwave energy

DOPPLER effect is the shift in frequency that occurs when radiated energy bounces off a moving object: the frequency difference between the incident and reflected signals provides a direct numerical indication of the speed of the moving object.

The principle is finding increasing use in small radar systems. A typical application with which motorists are unhappily aware is the radar speed trap. The Doppler principle is also used as a movement or velocity detector in intruder alarms, collision avoidance systems for aircraft, boats and railway stock, and in experimental form as collision avoidance and moving headway control systems for automobiles and trucks.

A typical Doppler system (using electro-magnetic radiation) is shown in Figure 1. Radio energy is produced by the RF generator. An antenna beams the RF signal toward the moving object. A small part of this radio energy is picked off before it reaches the antenna and sent to a mixer. This is the Doppler reference signal and will be compared with the signal returning from the moving object: the moving target reflects a portion of the transmitted signal back toward the receive antenna. The returning signal passes to the mixer. The mixer combines the reference signal from the RF generator with the shifted return signal from the moving target.

Its output is a signal whose frequency is the difference between the reference signal and the signal reflected from the moving target. This signal will have a frequency in the audio portion of the spectrum from perhaps 10 Hz to 2 or 3 kHz, depending on the speed of the moving object. The output of the mixer is fed to an audio amplifier to boost the signal to a level that makes it

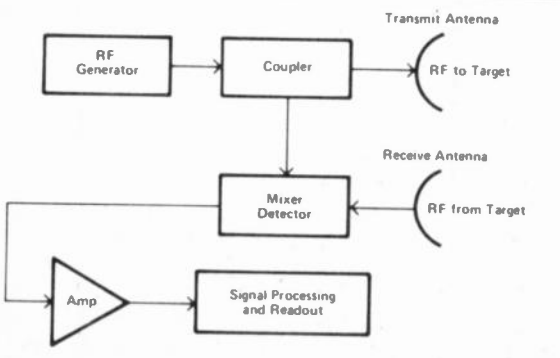


Fig. 1. Typical Doppler System.

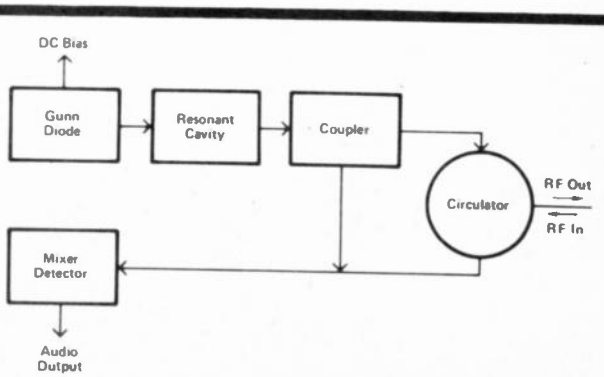


Fig. 2. Block Diagram of Hewlett-Packard's Doppler Radar Module.

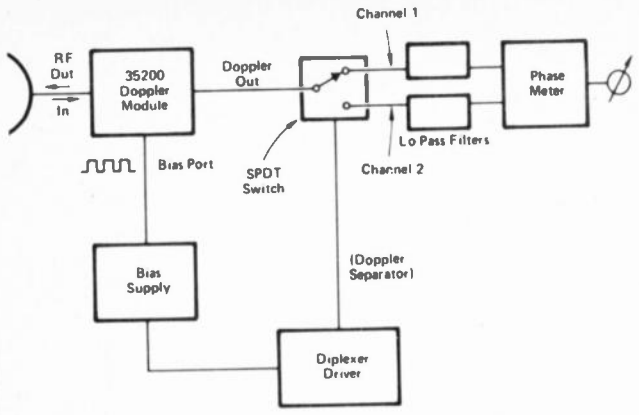


Fig. 3. Block Diagram of Doppler Ranging Radar.

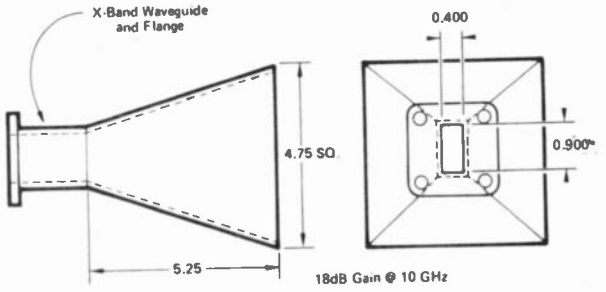


Fig. 4. General Purpose Antenna.

convenient for processing and readout.

The specific nature of the signal processing and readout circuitry will, of course, depend upon the task for which the Doppler radar system is being used. In their simplest form, these circuits merely provide a dc voltage to drive a meter.

Hewlett Packard have recently introduced a range of solid state X-band (9.35 to 10.6 GHz) doppler radar modules of small physical size. An adaptor enables these modules to be mounted direct on a standard X-band wave guide or antenna.

A block diagram of the module is shown in figure 2, and as can be seen, all of the typical system elements up to the mixer are included.

The RF generator, in this case, is a Gunn diode driving a resonant cavity. Gunn diodes are solid-state replacements for microwave vacuum tubes. They operate on low voltage (12 volts or less), have extremely good life, and are less expensive than their vacuum tube counterparts.

The Doppler system shown in Figure 1 uses separate transmit and receive antennae, Hewlett Packard's module eliminates the need for separate antennae by including a circulator at the output of the transmitter loop and the input of the receiver loop. The circulator isolates the outgoing and incoming RF signals from each other, even though they pass in and out through a common port and use a common antenna. The circulator thus cuts antenna costs in half. Circulators built into a thin film circuit add far less to the cost of the Doppler system than do circulators built from discrete components. Thus, the antenna savings that are achieved by using a circulator are true savings.

The circulator also serves to isolate the Gunn device from being unduly influenced by excessive reflections from targets that are very close to the antenna. Such reflections, if unchecked, lead to frequency "pulling" (a shift in frequency) that can interfere with system performance.

As in the discrete system, a mixer is used to compare outgoing and incoming signals. Its output is then fed to an external low noise audio amplifier and additional processing and readout circuits as required.

The Doppler radar modules operate at frequencies around 10 GHz. At this frequency, each mile per hour of target velocity will produce a signal at the mixer output of about 31 Hz. The exact expression for the Doppler shift is given by: $f_d = \frac{vfrf}{c}$

where f_d = Doppler shift frequency in hertz
v = target velocity in meters/sec
c = speed of light = 3×10^8 meters/sec
f_{rf} = frequency of RF output in hertz

For example assume that a target is moving with a velocity of 10 metres per second (approx. 22 mile/hr), and that the radar is operating at 10GHz.

$v = 10$ metres/sec
$c = 3 \times 10^8$ metres/sec
$f_{rf} = 10^9$ Hz

$$fd = \frac{2.10.10^{10}}{3 \times 10^8} = \frac{2000}{3} = 666 \text{ Hz}$$

Thus a Doppler frequency range of 300 Hz to 3kHz will cover target velocities of from approximately 10 to 100 miles per hour.

RANGE CALCULATIONS

A Doppler system is, of course, simply a transmitter and a receiver in one package. The effective range of such a system depends on how much energy gets back to the receiver from the target and how strong that signal must be to make the receiver work properly.

As in any receiver, for a given signal processing scheme, a certain level of input signal relative to the noise of the receiver (signal-to-noise level) will be required. This figure must be added to the noise power of the receiver to determine what input signal level is necessary to get successful detection.

In the Doppler module, receiver noise power is a function of the noise generated by the Gunn diode local oscillator and the conversion loss of the mixer.

Conversion loss is an inverse function of total detector current; i.e., the sum of the RF induced component and any externally applied dc component. The noise power contribution of the local oscillator (the Gunn device) goes up as a function of the RF induced mixer current.

To minimize receiver noise power, the oscillator is therefore isolated from the mixer to keep its noise contribution down and a dc mixer bias from an external supply is used to keep the conversion loss from being too high.

Provided the optimum bias is applied and assuming:

1) Antenna gain of 20dB (easily attainable at X-band)
2) doppler bandwidth of 30Hz to 3kHz
3) signal 10dB above noise is required.

The following range figures would be obtained.

Target	Range
10' diameter sphere	900 feet
car	800 feet
man	600 feet

DOPPLER RANGING

The Doppler module can be adapted to give range information as well as velocity. One successful method for accomplishing this task is to use a diplex phase comparison technique as shown in figure 3. The output from the Doppler module can be "switched" or diplexed between two closely spaced frequencies by

modulating the Gunn oscillator bias with a square wave. A comparison of the phase difference between the subsequently received signals from the target gives a direct measure of range. It can be shown that range is given by:

$$R = \frac{c}{2\omega_1}(\phi_1 - \phi_2)$$

where R = range

c = speed of light

ω_1 = frequency difference of the two RF signals

$(\phi_1 - \phi_2)$ = phase shift of one Doppler wave with respect to the other

This system gives unambiguous readings of both range and direction so long as the range is less than $\frac{\pi c}{2\omega_1}$. As the range goes beyond the value, ambiguity can occur. Frequency differences between the two transmitted signals of 500 kHz give good range reading out to 500 feet.

The diplexing or switching rate must be chosen such that the time delay of the return signal is much less than the period of transmission at any one frequency. A 100 kHz switching rate is adequate for ranges of about 500 feet, but is still fast enough to give a sufficient "sampling rate" to provide good resolution if the range is changing rapidly with time.

A block diagram of a typical system is shown in Figure 3.

OUTPUT SIGNAL

The output signal from the mixer is typically 1-50 microvolts, depending on target distance and size. To drive most processing equipment a low noise amplifier with at least 60dB of gain is therefore required. A further requirement of this amplifier is that low and high frequency cut-offs should be pre-settable as the module noise power contribution increases with doppler bandwidth thus reducing maximum range.

ANTENNAE

The type of antenna to be used with the Doppler module depends, in large measure, on the particular end use to which the module will be put.

Figure 4 shows a design for a simple, general-purpose antenna that could be used in many applications. Such an antenna can be fabricated from standard X-band waveguide and sheet metal. To obtain a good match, care should be taken to see that all joints are true and smooth.

The advent of these solid state doppler modules will significantly ease the price of commercial radar equipment. Interface is relatively easy and only a single +9 to +12 Volt supply is necessary. Perhaps every police car will soon have a portable doppler speed trap as standard equipment!

Potential users should be warned that in Australia, PMG rules governing the use of radio transmitters apply to this module. The user is cautioned to check these rules before using the module in his particular application. In almost all cases it would be necessary to obtain a license to operate the unit.●

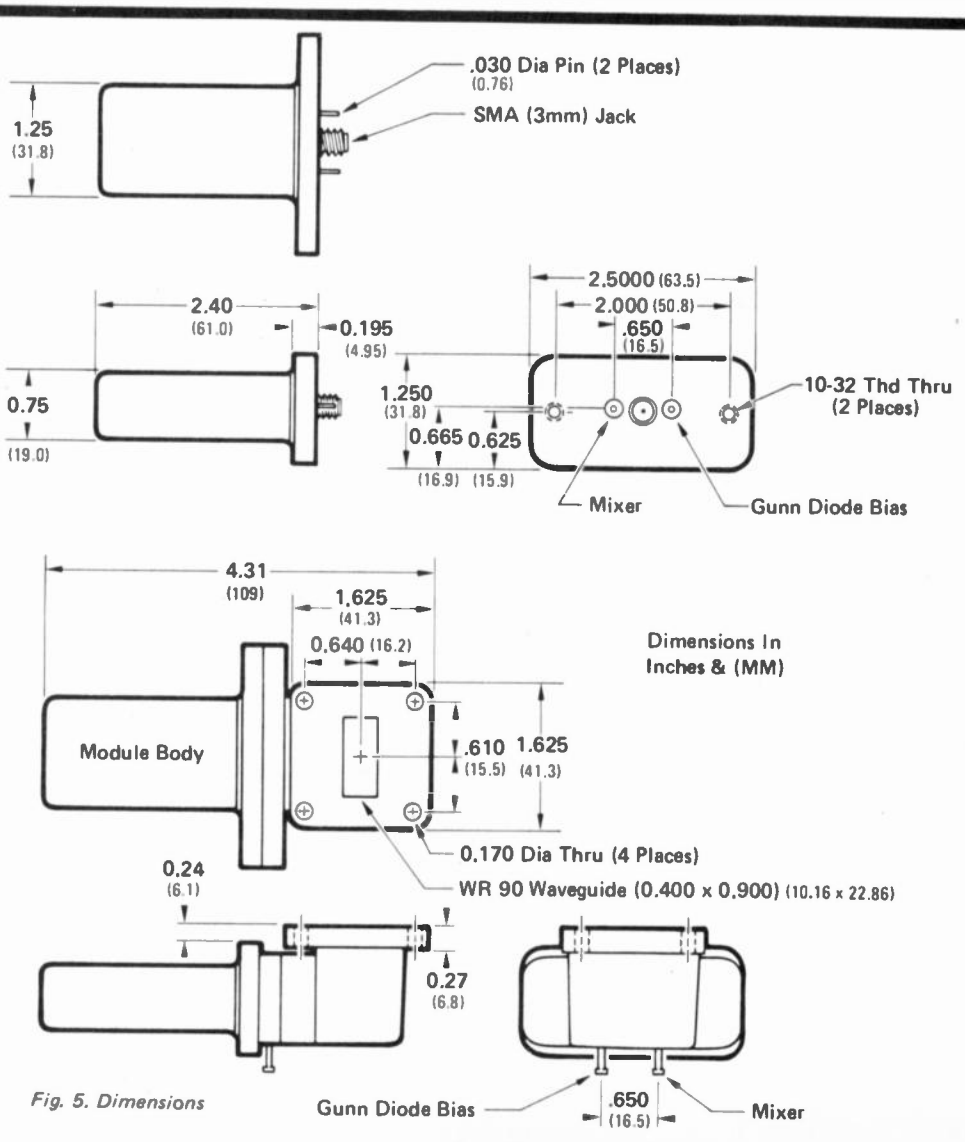
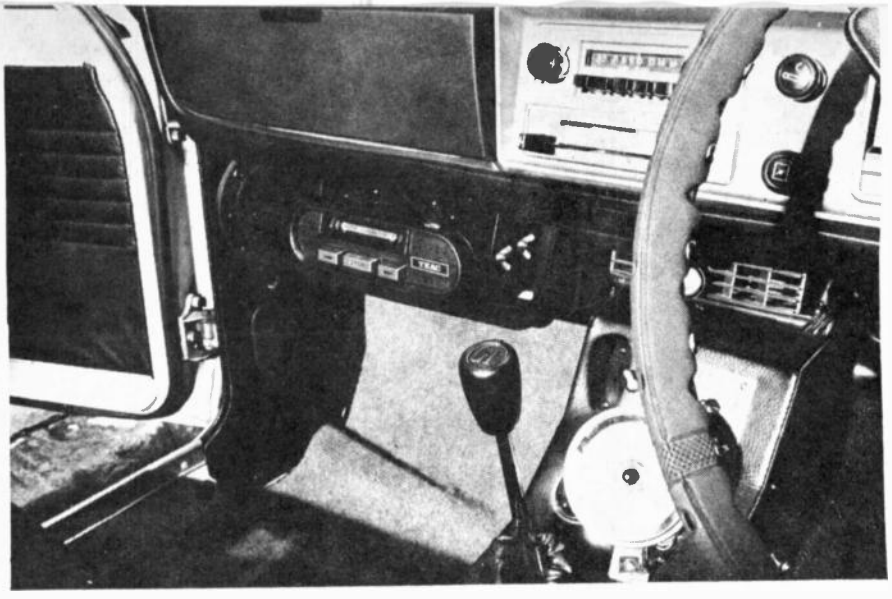


Fig. 5. Dimensions



electronics TODAY product test

TEAC AC-7 'AUTO-CASSETTE'

TEAC's AC-7 car cassette player provides excellent sound quality — Rob Giumelli reports . . .

DESPITE recent advances in car radio design, the quality of radio reception is still very poor in country areas. Even were it otherwise, many listeners are somewhat less than enthusiastic about the choice of programme material.

Hence the ever-growing acceptance of cartridge and cassette players designed specifically for vehicle use.

The first car tape system was introduced by Californian 'Madman' Earl Muntz — this was a four-track continuous-loop cartridge player. Muntz' unit was soon challenged by the Lear Jet Corporation's 8-track player. Recently several manufacturers have marketed 4-track *cassette* players.

Initially the cartridge player dominated the market. Its protagonists could truthfully claim that the format's higher operating speed (3¾ ips) provided better frequency response and signal/noise ratio than could then be obtained from cassettes, but recent developments in both tapes and cassette recorders have negated these advantages and the cassette player now has a substantial share of the market.

Nevertheless the cartridge people are not exactly turning the other cheek, and several manufacturers including Motorola, Automatic Radio and Toyo have introduced quadrisonic cartridge systems.

So far there has been no equivalent four-channel format in cassette form — mainly because Philips (inventors of the cassette system) require licencees to use track widths so narrow that signal/noise ratio and channel separation become major problems.

ELECTRONICS TODAY's recent test of TEAC's AC-7 'Auto-Cassette' dramatically demonstrated the advances that have been made in the cassette format in the past year or two.

The stereo cassette unit is delivered in two study cardboard boxes, one containing the player itself, the other containing the two speaker assemblies. Comprehensive, well-illustrated fitting instructions are included.

The player unit may be installed either vertically or horizontally. It is located by a simple bracket that in turn is bolted to the vehicle by two expansion bolts. The angle of attachment may be adjusted by using alternative slots in the mounting bracket.

A most useful feature is a locking device to protect the unit from theft.

The speakers, mounted on the rear parcel shelf, may be either flush mounted or left protuding. For flush mounting, it is only necessary to remove the front grill from the speaker enclosure, sink the speaker into the parcel shelf and replace the grill. With the hardware supplied it should be quite feasible even to mount the speakers in the front doors.

Wiring could not be simpler. A cable harness, consisting of six cables, comes pre-cut to length and fitted with connectors. With this arrangement it is inconceivable that any mistake could be made. However, a trouble shooting chart is supplied. Complete installation of this unit should take a maximum of thirty minutes.

As car stereo systems have to compete with wind, engine and road noise — apart from the racket of other traffic — their frequency response is deliberately limited to less than 10kHz, and conventional objective testing methods have little meaning. Ease of installation, reasonable power output (12 Watts 'music power' in the case of the TEAC), freedom from movement-caused wow and flutter and safe, pleasant styling are more important than absolute flatness of response.

In all these areas the TEAC scored well, and subjectively at least, its sound quality was far better than quite a few so-called hi-fi units sold for domestic use.

Apart from providing excellent performance in cars, the TEAC AC-7 'Auto-Cassette' is particularly well suited to commercial vehicles and beach buggies (and other rough terrain vehicles) as no wow or flutter could be heard, even on the roughest roads. ●

TEAC AC-7
'Auto-Cassette'
(manufacturer's specification)

Track: 4 track 2 channel, stereophonic
Tape speed: 1-7/8 ips
Wow and flutter: 0.25%
Output: 12W (6W x 2) - 1.H.F.
Frequency response: 40-10,000 Hz
Power requirement:
dc 12V negative ground
Power consumption: 0.5A
Dimensions:
9" (W) x 7½" (D) x 2¾" (H)
Weight: 3 kg (6.6 lbs)
Price:
$198 (recommended max retail price

PHOTOGRAPHIC TIMER

PROJECT 512

This unit provides reliable and accurate timing of photographic processes.

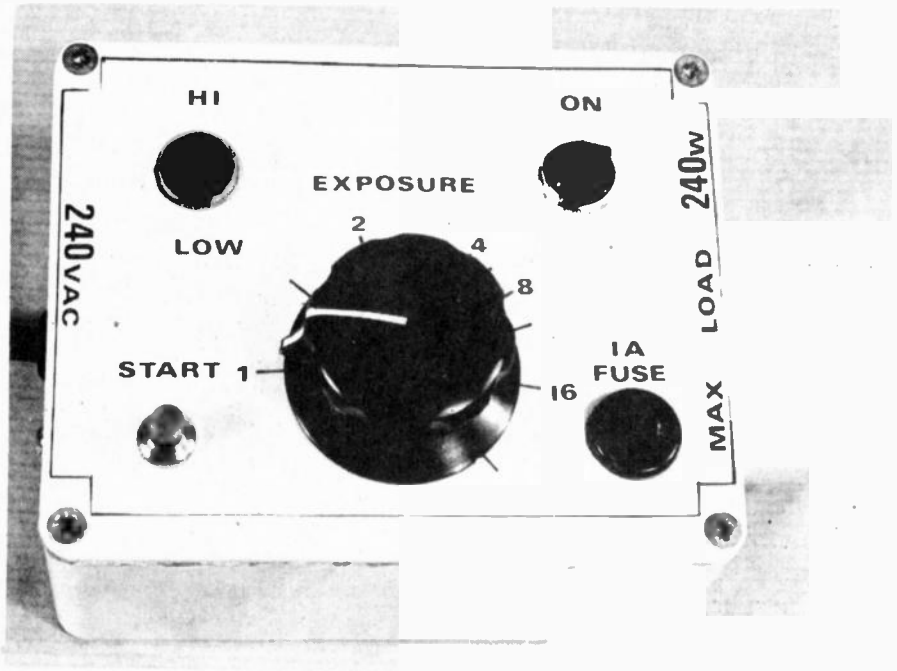


Fig. 1. The completed photographic timer.

ACCURATE, dependable timing of photographic printing processes is essential to avoid costly wastage of paper.

ELECTRONICS TODAY's process timer provides just this.

The unit ensures precise and repeatable timing from less than one second to over 300 seconds.

The wide timing range of the instrument allows it to be used as an enlargement exposure or development timer. This dual application makes the unit superior to all but the most expensive commercial timers that are usually only suitable for one or the other of the above tasks.

CONSTRUCTION

By far the easiest method of construction is by the use of a printed circuit board, and this is the method we used in our prototype. However, layout is not critical and any other construction methods, such as veroboard, may be used if desired.

It must be firmly kept in mind that the unit is connected directly to the mains power and the circuitry is "above earth". Therefore, good workmanship is essential with particular attention being given to such points as clearances and insulation.

Our unit was constructed in a diecast aluminium box which although a little expensive, is convenient and results in a very professional appearance.

Full drilling details for this box are given in Fig. 4. If a different box is used it may be necessary to vary the layout somewhat.

Assemble the components to the board in accordance with the component overlay Fig. 5. Make sure that all components are mounted the right way round as shown in the overlay.

Leads should now be soldered to the

HOW IT WORKS

The 240V ac mains is rectified by D1-D4. Resistor R1 drops this voltage down to about 20V and capacitor C1 provides smoothing.

The main control device SCR1 (C106D1) and the load connected in series with its anode are connected across the rectified mains. The SCR being a two state device – is either non-conducting, or conducting. If the SCR is turned on by a pulse or a dc potential on its gate it will remain on as long as there is a dc potential at the gate or current is flowing in the anode circuit. The anode current will drop to zero every half cycle as the mains voltage passes through zero (resistive load). With this circuit a dc potential is applied to the gate for a preset time interval. The SCR will be on for this time plus the time remaining in the half cycle during which the control signal is removed.

Transistors Q2 and Q3 form a flip flop having two stable states. These are – Q2 on and Q3 off, or Q2 off and Q3 on. If Q3 is on, the voltage at its emitter will be high and the SCR will also be on. Pressing PB1 applies a "turn on" pulse to the base of Q3. The consequent drop at Q3 collector is passed to the base of Q2 turning Q2 off.

When Q2 turns off, capacitors C2-C6 begin to charge via RV1 and R7. These capacitors are across the emitter of the unijunction transistor Q1. The emitter appears as an open circuit until the capacitors reach about 60% of the supply voltage. When this point is reached the emitter-B1 junction of the unijunction becomes a very low resistance and the capacitors are discharged through R4. The resulting pulse across R4 is coupled to the base of Q2 by R2 turning Q2 on and Q3 off thus ending the timing cycle.

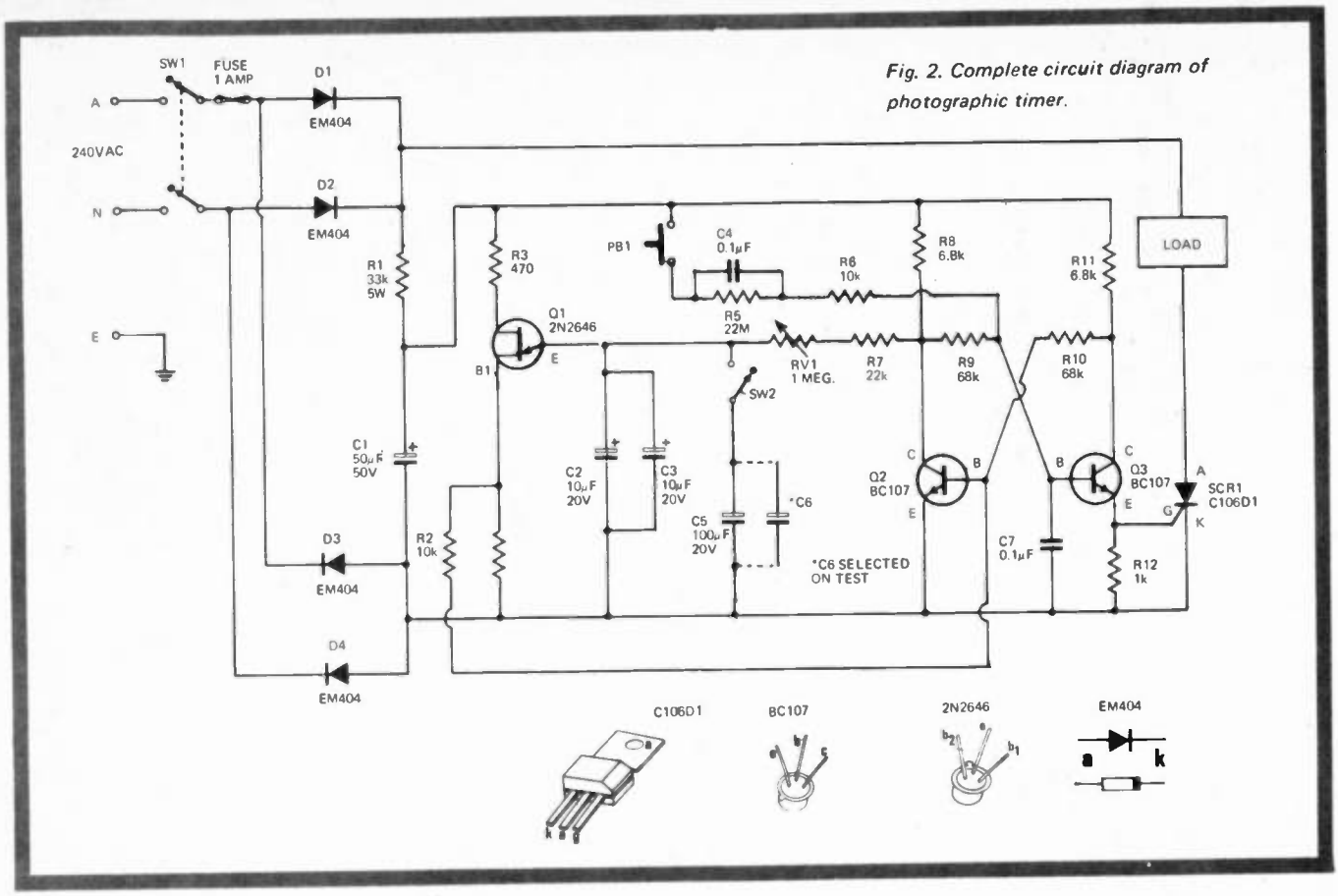


Fig. 2. Complete circuit diagram of photographic timer.

board for later connection to the switches and other components mounted directly on the box. Assemble the completed board into the bottom of the box using half inch spacers, making absolutely certain that all wiring and components are clear of the case.

Mount all external components on the box and wire them in accordance with Fig. 5. Note that where wires pass through the metal case a rubber grommet must be used. Instal the mains cable and secure it with a proper clamp. The practice of tying a knot in the cable is highly dangerous, illegal, and should not be used. The earth lead of the cable should be firmly bolted to the case. Check the unit thoroughly to ensure that all wiring has been properly performed before switching on.

TEST AND CALIBRATION

Remember that this unit operates at mains potential. Before attempting to make any internal changes or adjustments, switch off and remove the power plug from the mains outlet.

Connect a lamp load not exceeding 240 watts. Plug the unit into the mains outlet and switch on. A short flash from the lamp may occur at initial power switch-on and is quite normal.

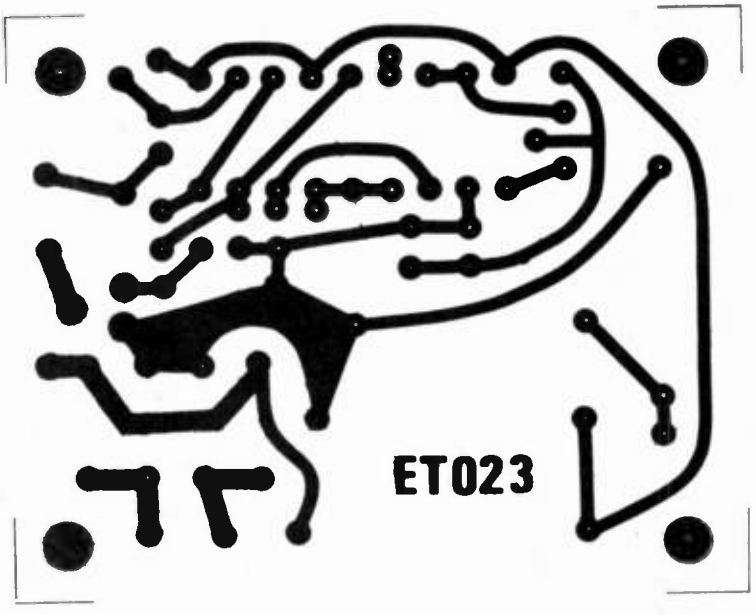


Fig. 3. Foil pattern for printed circuit board.

KITS

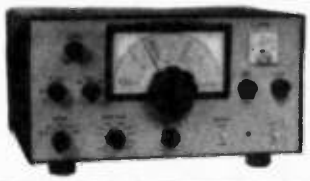
AMPLIFIERS – PREAMPLIFIERS – TUNERS – CONTROL UNITS – GUITAR UNITS – INSTRUMENTS – INVERTERS – CONVERTERS – RECEIVERS – TRANSMITTERS – REGULATED POWER SUPPLY – TRANSISTOR AND VALVE TYPES.

KITS

1970 - COMMUNICATIONS RECEIVER - 240

SOLID STATE

FULL KIT OR INDIVIDUAL PARTS ONLY



MAJOR STOCKISTS OF ALL GENERAL RADIO & ELECTRONIC COMPONENT PARTS -- YOU NAME IT -- WE WILL QUOTE

VALVES – TRANSISTORS – ZENER & POWER DIODES – SEMI-CONDUCTORS – DIACS – TRIACS – S.C.R'S. – I/C'S. SPEAKERS – MICROPHONES – COILS – IFT'S. TRANSFORMERS – INST CASES – METALWORK. PLAYERS & CHANGERS – METERS – RELAYS – CONDENSERS – RESISTORS – BEZELS – STYLII – CARTRIDGES – RECORDING TAPE – PROBES – INSTRUMENTS – POTENTIOMETERS – CRYSTALS – FERRITE BEADS – CORES – BALUNS – TERMINALS – CO-AXIAL PLUGS & SOCKETS – MULTI CONNECTORS – PRINTED CIRCUIT BOARDS – COPPER WINDING WIRE – ETC. – ETC. –

POPULAR KITS - TOP QUALITY - LOWEST PRICES

INSTRUMENTS C.R.O.
1. 5in wide range.
2. 1963. 3in cal.
3. Audio.
4. 1966. 3 in.
5. 1968 — Audio.
6. Electronic SW.
7. W/band.

MULTIMETERS and V.T.V.M.'s
8. 20K ohm/Volt protected M/M.
9. Probe for above.
10. Protected D.C. M/M.
11. Meterless V'meter.
12. A.C. Millivoltmeter
13. A.C. Solid State Millivoltmeter.
14. Solid State A.F. Millivoltmeter.
15. Noise Distortion Millivoltmeter.
16. Standard V.T.V.M.
17. 1966 — V.T.V.M.
18. 1968 — V.T.V.M.

BRIDGES
19. Standard R/C.
20. 1966. R/C.
21. 1968 R/C and Signal Injector.

TV INST.'s
22. Sweep and marker Generator
23. Dual sweep Gen.
24. Silicon diode. sweep Gen.
25. Silicon diode noise Gen.
26. Pattern Gen.
27. Trans. pattern Gen.
28. Wild range pulse Gen.

AUDIO INST.'s
29. 1960 Audio Osc.
30. 1962 High perf. audio Gen.
31. Crystal locked std.
32. Electronic tuning standard.
33. 1965. Solid State audio osc.
34. Direct reading A.F. meter.
35. Sq. wave Gen.
36. 1967 transistor audio Gen.
37. Additive frequency meter.
38. A.F. tone burst gen.
38A. 1968. Solid State A.F. Generator.

R.F. INST.'s
39. 6-band service oscillator.
39A. Trans. wave meter.
40. "Q" meter.
40A. Crystal Calibrator — Solid state.
40B. Digital freq. meter.
40C. 1969. Dip Osc. — Solid state.
41. G.D.O. wide range.
42. G.D.O. adaptor.
43. Trans. service osc.
44. Simple signal injector.
45. Transistorised signal tracer.
46. Transistorised osc.
47. Basic test osc.
48. Transistor test.
48A. IF. Align Osc.

MISCELLANEOUS INST., ETC., KITS
49. 1960. Trans. Tester.
50. 1968. Transistor est set.
51. Valve and Transistor tester.
52. Electronic Stethoscope.
53. Moisture alarm.
54. Electronic Pistol range.
55. Transistor Geiger Counter.
56. Light beam alarm.
57. Burglar alarm.
58. Flasher unit.
59. Transistor alarm.
60. Electronic switch.
61. Photo Timer.
62. Direct reading Impedance meter.
63. Electronic anemometer.
64. S.W.R. Indicator.
65. Simple proximity alarm unit.
66. Metal Locator.
67. Electronic metronome.
68. Bongo Drums.
68A. Keyless organ.
68B. Theremin.
68C. Laser unit.
68D. Color organ.
68E. Stereo Headphone Adaptor.

BATTERY CHARGERS
69. Universal unit.
70. 1 amp unit.

REGULATED POWER SUPPLIES
71. Transistor, 9v.
72. Transistor, fully protected supply.
73. 1966 H.T. unit.
74. 1968 lab. type. D-30v supply.
74A. Simple pwr. supply

VOLTAGE-CURRENT CONTROL UNITS
75. Vari-watt unit.
76. Vari-tach. motor speed control.
77. 2KW auto-light dimmer.
78. 4KW auto. light dimmer.
79. Model train control unit.
79A. Vari Light Dimmer.
80. Model train control unit with simulated inertia.
81. Above-hi-power.
82. No. 81 with simulated inertia.

TACHOMETER UNITS
83. 6 or 12v Std.
84. 6 or 12v Mullard.
85. 6 or 12v with dwell angle.
86. Tachometer and dwell angle unit for service stations.

TRANSISTOR IGNITION
87. Ro-Fo. 6 or 12v.
88. Hi-Fire 6 or 12v (transformer).
88A. C.D.I. unit.
88B. Electronic ignition.

POWER CONVERTERS
89. D.C.-D.C. 60w.
90. D.C.-D.C. 40w.
91. D.C.-D.C. 40w. 12v—Input.
92. D.C.-D.C. 70w. 12v—Input.
93. D.C.-D.C. 100w 12v—Input.
94. D.C.-D.C. 140w. 24v—Input.
95. D.C.-D.C. 225w 24V — input Q.

HIGH-FIOELITY AMPLIFIERS MONO UNITS
96. Hi Fi 3.
97. Mullard 3.3.
98. Mullard 5-10.
99. Mullard 5-10. transistor.
100. Transistor 20w.
101. Transistor 60w.

STEREO UNITS
102. Mullard 2-2.
103. Mullard (v) 3-3.
104. Mullard (t) 5-5.
105. Mullard (t) 5-5.
106. Mullard (v) 10-10.
107. Mullard (t) 10-10.
108. Philips Twin 10.
111. Hi-Fi 60 Plus 60. P/M 128.
112. Playmaster 2-2.
113. Playmaster 3 plug 3.
114. Playmaster unit 3.
115. Playmaster unit 4.
116. Playmaster 10 plus 10.
117. Playmaster 101.
118. Playmaster (t) 105.
119. Playmaster (t) 113.
120. Playmaster (t) 115.
121. Playmaster (v) 118.

P.A. UNITS
122. 10 watt std.
122A. Mullard 20w Solid state.
122B. Mullard 40w, Solid state.
123. 25 watt std.
124. 35 watt std.
125. 30 watt (t).
126. 100 watt std.
127. Stereo P.A.

GUITAR UNITS
128. 10 watt std.
129. 25 watt std.
130. 35 watt std.
131. 50 watt std.
132. 70 watt (t)
133. Playmaster 102.
134. Playmaster 103.
135. Playmaster 40w. 116.
135. Playmaster 60w 117.
137. Guitar fuzz box.
138. Guitar Waa-Waa.
139. Reverb unit.
140. Guitar preamp.
140A. Guitar 50w Solid State P/M 125.

STEREOGRAMS
141. Playmaster 105.
142. Playmaster 106.
143. Playmaster 107.
143A. Playmaster 124.

CONTROL UNITS
144. Playmaster No. 9.
145. Playmaster No. 10.
146. Playmaster No. 104.
147. Playmaster No. 112.
148. Playmaster No. 120.
149. Mullard 2v.
150. Mullard 3v.
151. Phillips Miniwatt.
152. P/M 127.

PREAMP UNITS
153. Transistor — Mono.
154. Transistor — Stereo.
155. Transistor — Silicon. mono.
156. Transistor F.E.T. mono.
157. Transistor dyn. mic. mono.
158. Above-Stereo.
159. Playmaster 115 F.E.T. Stereo.
160. Playmaster 115 mag.
161. Sound projector.

MIXER UNITS
162. Trans. 4 ch. (1966).
163. Trans — 4 ch. (1967).
164. Valve — 4 ch.

TUNER UNITS
165. Playmaster u/style.
166. Playmaster No. 11.
167. Playmaster No. 114.
168. Playmaster No. 122.
196. Playmaster No. 123.
170. Philips Miniwatt.
180. Trans — Long range.

TAPE UNITS
181. Trans. Preamp.
182. Playmaster 110 (M)
182. Playmaster 110 (S)
183. Power Unit 110.
184. Adaptor 110.
185. Playmaster 119. Adaptor.
186. Transistor V.O.X.
187. Tape Actuated relay.
188. Mullard Trans Tape Amp.

RECEIVERS
189. Fremodyne 4. 1970.
190. Fremodyne 4 R.F. Sect. only.
191. Synchrodyne.
192. Communications RX.
193. Detalhet RX.
194. 3 Band Double Change S/het RX.
195. Explorer VHF Transistor RX.
196. Interceptor 5 Semi-Comm. RX.
197. 1967. All-Wave 2.
198. 1967 All-Wave 3.
199. 1967 All-Wave 5.
200. 1967 All-Wave 6.
201. 1967.All-Wave 7.
202. Transporta 7.
203. Transistor 8 3 Band.
204. 3 Band 2V RX.
205. 3 Band 3V RX.
206. All Wave 1970 I/C2.
207. Versatile Mantel Set.
208. All-Wave Transistor 3.
209. A.B.C.
210. 1968 F.E.T.
210A. I/C TRF RX.
210B R.F. Preamp.
210C. "Q" Multiplier.
210D. 1970 Communications Solid state.

TRANSMITTERS
211. 144 MHz 50W. Linear Final.
212. 144 MHz 20W
213. 144 MHz 20W.
214. 144 MHz 18W.
215. 144 MHz S.S.B.
216. 3 Band A.M.
217. Basic 3 Band.
218. 5 Band S.S.B.
219. 1967 S.S.B.

CONVERTERS
220. 50 MHz.
221. 144 MHz. 1970.
222. 50 and 144 MHz Crystal Locked.
223. 1965 S/W.
224. 1965 S/W 2 Band
225. 1966 3 Band
226. Basic S/W.

V.F.O. UNITS
227. Remote Unit.
228. 7. 8 and 9 H.F. and V.H.F.
229. All transistor.

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PHOTOGRAPHIC TIMER

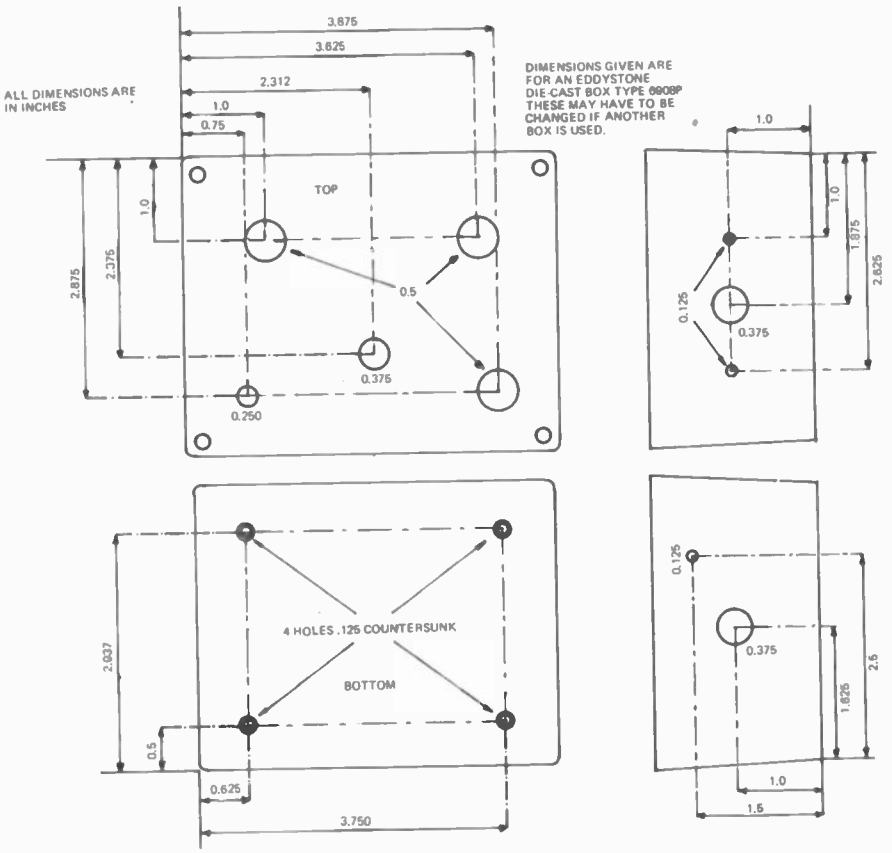

Fig. 4. Drilling details for cast aluminium box.

PARTS LIST ET 512

All resistors ½ watt 10% unless specified otherwise.

R1	resistor	33 kohm 5W	10%
R2	resistor	10 kohm	
R3	resistor	470 ohm	
R4	resistor	100 ohm	
R5	resistor	22 Mohm	
R6	resistor	10 kohm	
R7	resistor	22 kohm	
R8	resistor	6.8 kohm	
R9	resistor	68 kohm	
R10	resistor	68 kohm	
R11	resistor	6.8 kohm	
R12	resistor	1 kohm	
C1	capacitor	50µF 50V electrolytic	
C2	capacitor	see text	
C3	capacitor	see text	
C4	capacitor	see text	
C5	capacitor	see text	
C6	capacitor	0.1µF 100 V	
C7	capacitor	0.1µF 100 V	
Q1	transistor	2N2646	
Q2	transistor	BC107	
Q3	transistor	BC107	
SCR1	SCR	C106D1	
D1-D4	diodes	EM404	
PC board	ET 023		
SW1	switch, on-off, 2 pole 240V 1 amp MSP type 625 or similar		
SW2	switch, on-off, 1 pole MSP type 625 or similar.		
PB1	push button single contact push to make.		

Metal box Eddystone type 6908P or similar, wire, 3 core flex and plug, 3 pin socket.

Select the low range, minimum time and press the start button. The light should come on for less than one second. Now turn to maximum time and press the start button again. The timer should now stay on for about 30 seconds. Perform the same procedure again on the high range, the time range should now be about ten times that obtained on the low range.

The calibration of the timer may vary widely from unit to unit due to component tolerances and timing capacitor leakage. Tantalum capacitors have been recommended for this unit because of their relatively low leakage. These capacitors are expensive and may be replaced by ordinary electrolytics with some deterioration in performance. Different scales would then be required for each of the two ranges due to the higher leakage of these capacitors.

Calibration is performed by selecting the value of C2 or C3 to obtain the desired time range on "low" and C5 or C6 for the desired time range on "high".

On the scale as shown in Fig. 7, the calibration is from one to sixteen, the graduations being at half stop intervals. Capacitor values should be trimmed to make the time range

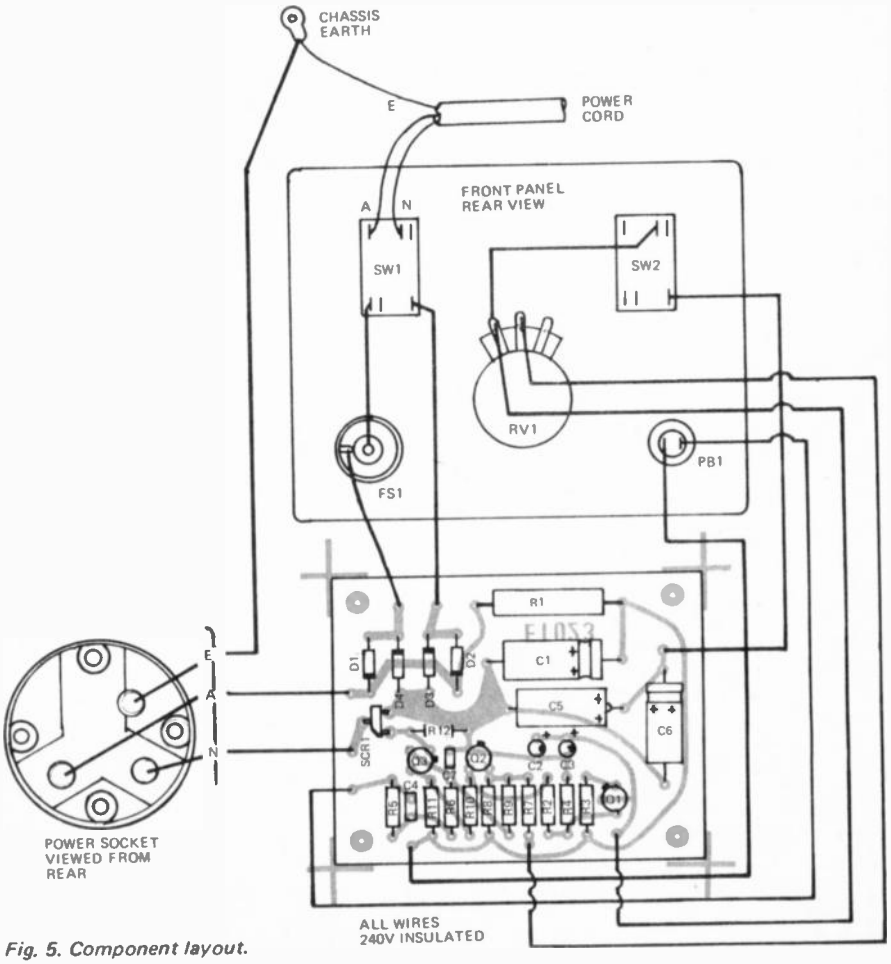

Fig. 5. Component layout.

PHOTOGRAPHIC TIMER

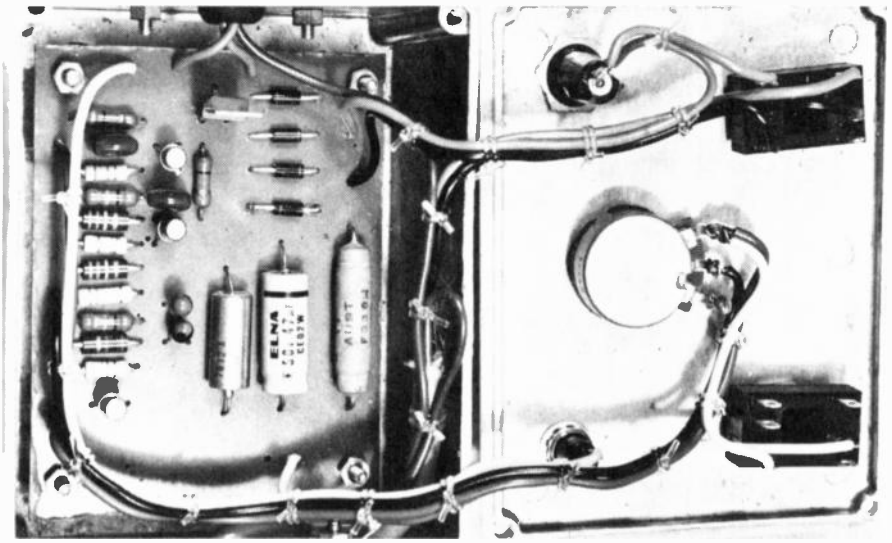

Fig. 6. Internal layout of the timer.

SPECIFICATION		
Power	maximum load	1 amp (240W).
Time	(low range)	1 sec — 30 sec.
	(high range)	10 sec — 300 sec.

Time ranges simply selectable by change of capacitance values.

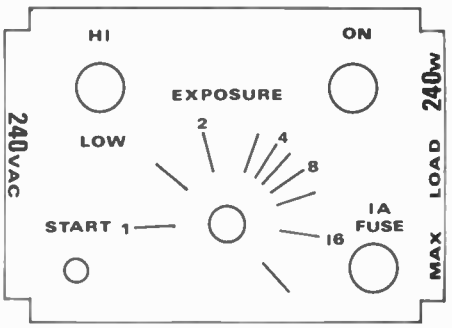

Fig. 7. front panel marking reproduced half size.

correspond to the scale markings. This is done by increasing capacitance to extend the time interval, or reducing capacitance to shorten the time interval.

The same procedure should be used if different time scales are required, the same scale graduations but different time figures are used. However it should be borne in mind that capacitor leakage may well prevent the practical realisation of time intervals much longer than 300 seconds. ●

Get the measure of this meter—

it's got all the advantages of a VTVM...with instant warm up

Kyoritsu

MODEL K-200

FET•METER

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RANGES (PEAK TO PEAK): 0-0.84, 2.8, 8.4, 28, 84, 280, 840 and 2800 FULL SCALE, FREQUENCY COMPENSATED.
INPUT RESISTANCE: 10 MEGOHMS
INPUT CAPACITANCE: APX. 50PF IN 0.3V RANGE, APX. 35PF IN OTHER RANGES.
TEST CORD-APX. 80PF
FREQUENCY RESPONSE:
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20Hz~3MHz (OTHER RANGES) ±1 dB
ACCURACY: ± 4% FULL SCALE

OHMMETER (7 ranges)
RANGES: Rx1/x10/x100/x1K/x10K/x100K/x1M
MID SCALE: 10Ω (AT SCALE OF Rx1)
ACCURACY: ±3% SCALE LENGTH

DC CURRENT (8 ranges)
RANGES: 0 TO 30μA/300μA/1/3/10/30/100/300mA
ACCURACY: ± 3% FULL SCALE

AC CURRENT (8 ranges)
RANGES: 0 TO 30μA/300μA/1/3/10/30/100/300mA
ACCURACY: ± 4% FULL SCALE

GENERAL
METER: 80 MICROAMP ± 2%
WEIGHT: 3.5 lbs
DIMENSIONS: 5.1 x 7.7 x 4.4 inch

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RADIO ASTRONOMY FOR AMATEURS

a series - by Roger Harrison VK3ZRY

In this instalment Roger Harrison describes ways and means of obtaining the necessary receiving and recording equipment.

A basic requirement of every radio-astronomer is some means of recording the received emissions. This should preferably be a chart recorder or tape recorder.

CHART RECORDERS

Chart recorders come in a multitude of shapes, sizes, chart speeds and writing methods.

The writing method does not particularly matter as long as a clear, permanent record can be obtained. Recorders that take a paper strip less than about 4 inches wide, or those that utilise a circular graph, are not suitable as they cannot be scaled with sufficient accuracy for this application.

Chart recorders are fairly expensive ($140 upwards), but if the project is being undertaken within a group, a new instrument can probably be afforded.

Second-hand chart recorders can occasionally be obtained — often at bargain prices. If you are fortunate enough to locate one, check that the galvanometer section is in good working order before buying. The condition of the chart drive mechanism is less critical and, if necessary the mechanism can usually be repaired or replaced.

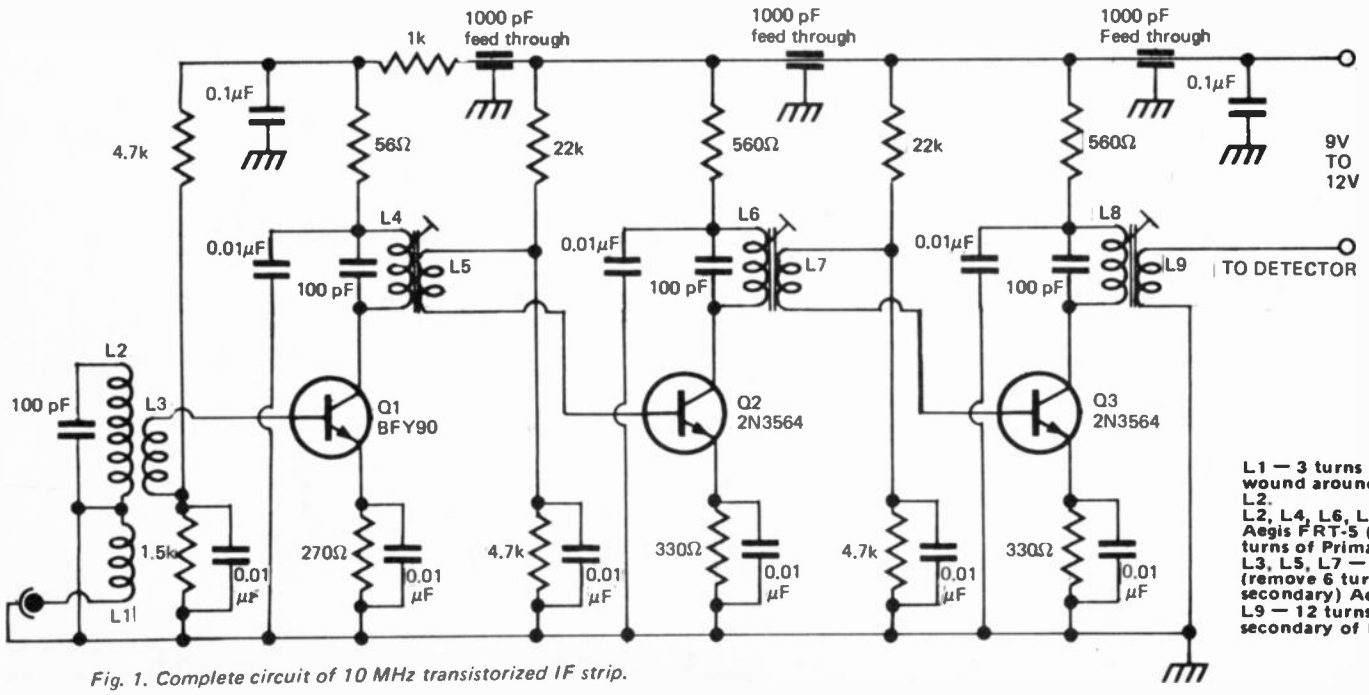
Preferably, the chart recorder should have two speeds. One speed should be fairly slow, say ½" or 1" per hour; the second speed should be faster, say 3" to 6" per hour.

It does not matter whether the chart is driven electrically — or by clockwork as long as the speed of the paper is fairly constant, (preferably better than 1 part in 10^4) and related to the graduations on the chart paper. For really accurate recording a crystal controlled chronometer can be arranged to mark time indications directly onto the chart paper.

TAPE RECORDERS

Practically any tape recorder can be used for logging radio-astronomy emissions. An expensive machine is not necessary.

The recorder's frequency response is immaterial, but wow and flutter should not be excessive. Most older



L1 — 3 turns hookup wire wound around cold end of L2.
L2, L4, L6, L8 — 16 turns, Aegis FRT-5 (remove 8 turns of Primary).
L3, L5, L7 — 6 turns (remove 6 turns of secondary) Aegis RFT-5.
L9 — 12 turns (full secondary of RFT-5).

Fig. 1. Complete circuit of 10 MHz transistorized IF strip.

RADIO ASTRONOMY FOR AMATEURS

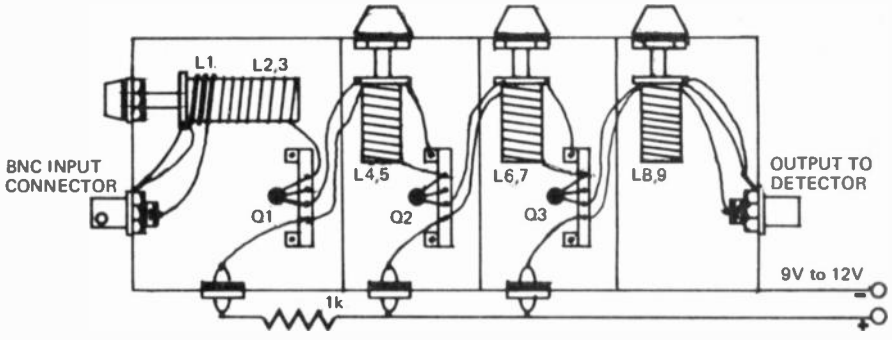


Fig. 2. Constructional layout of 10 MHz IF strip (only major components are shown).

tape recorders will do an excellent job; even the more modern cassette recorders are perfectly adequate for observations of relatively short duration.

The tape speed should be as slow as possible. If you can use a tape recorder that has a speed of 15/16 inches per second, so much the better – it saves tape. Unfortunately, few modern recorders are designed to run at this speed, in fact hardly any now include even a speed of 1 7/8 inches per second. Experimenters with adequate workshop facilities may be able to modify the drive mechanisms to reduce tape speed, but one must be careful not to degrade wow and flutter performance.

Apart from slow running speed, the larger the reels that can be accommodated on the recorder the better. This will enable long term observations to be made without interruption. A facility for putting time "pips" on the tape is worth keeping in mind, and will be discussed later.

Although not essential, a tape recorder used together with a chart recorder, enables a separate and additional record of events to be stored. For those who cannot afford a chart recorder, a tape recorder is the only other method available that will enable observations to be permanently stored. The tape recorded data can always be transferred to a paper chart later on.

THE BASIC RECEIVER SYSTEM

A good basic receiver is necessary. This should be a multi-purpose unit capable of being used either directly as a radio telescope receiver, or as an IF system for VHF or UHF conversion. This provides versatility and flexibility at minimum cost.

A receiver may be obtained from any one of the following sources:–

(a) New commercial communications receivers covering the range from 500 kHz to 30 MHz.

(b) Secondhand military or commercial communications receivers (fixed channel or tunable).

(c) Taxi, telemetry or radar receiver IF strip (often obtainable through surplus stores).

(d) Home built.

Commercial communications receivers, although expensive, offer good noise figure, high sensitivity, low cross modulation and flexibility. Receivers of this type generally cover the range 500 kHz to 30 MHz in several bands. The most useful frequency band for radio astronomy purposes is 15 to 30 MHz.

Make sure the specifications are as good or better than the following:–

Sensitivity – 1μV for 6dB S/N ratio (AM 30% mod 5kHz BW); Noise figure – 6dB; Stability – 1 in 10^5; Image rejection – better than 30dB on the highest range.

The above specifications are easily met by most commercial general coverage and communications receivers.

Many of the above remarks, and certainly the above specifications, apply to secondhand and military surplus communications receivers. Receivers such as the Murphy B40, Marconi CR100, and the RCA AR88 are eminently suitable, as are more recent types made by Collins and Hammarlund. In addition fixed channel HF receivers have become available through various outlets, and many of these are quite suitable.

It should be kept in mind that replacement components may be hard to obtain and difficult to install.

L2, L3, L5 — 16 turns (remove 8 turns from primary) Aegis RFT-5.
L1, L4, L6 — 5 turns (remove 7 turns from primary) Aegis RFT-5.

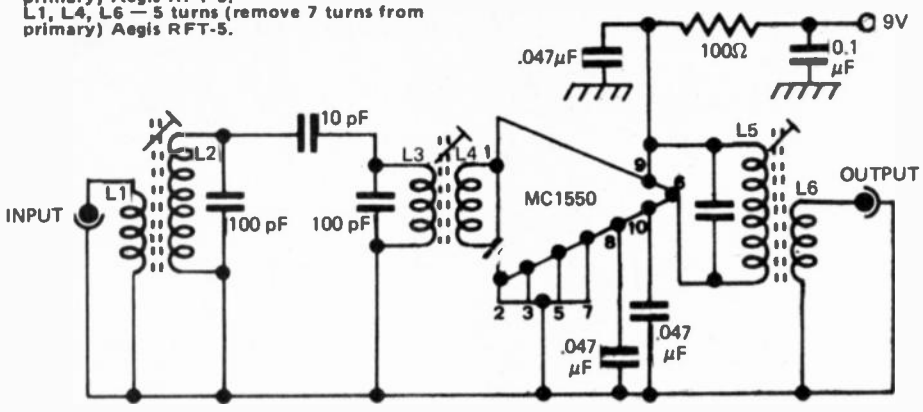


Fig. 3. Integrated circuit IF strip.

However a receiver in good working order when purchased should prove to be quite reliable.

Don't be afraid of valve equipment — but make sure to purchase a spare set of valves. Such equipment is readily obtainable from most disposal stores at fair prices.

Microwave, radar and telemetry receivers are usually produced with a low noise, high gain, fixed frequency, broad band IF strip. An IF strip of this type is excellent for use in a radiometer or following a high frequency converter. The most common IF frequency in use in such strips is 30 MHz, but other frequencies (such as 45MHz and 100MHz) are sometimes employed. The centre frequency of the IF should be determined before purchase.

IF strips obtained from mobile VHF transceivers (eg ex-taxi) are also excellent for the above purpose. Many of these transceivers (which may be AM or FM), are available on the surplus market. The FM units must be modified to provide AM detection. This is not difficult and details of this modification will be given later.

The gain, noise figure and stability of these IF strips are usually more than adequate. Automatic gain control, if used, should be disabled unless the unit is being used in a receiver such as the Ryle and Vonberg system described earlier in this series.

The front-ends of surplus VHF transceivers are generally not suitable for use in radio-astronomy receivers. Such units require considerable modification to obtain the desired operating frequency and noise figure. Unless suitable test equipment, or access to it, is available, such modification is best not attempted.

Home construction is worthwhile and there are many designs to choose from. The decision of which circuit to use, should be based on the criteria mentioned earlier.

If you contemplate building your own equipment, it would be wise to purchase a good reference book on receiver (and antenna) construction. An excellent one is the "Radio Communication Handbook" published by the Radio Society of Great Britain.

IF SYSTEM CIRCUITS

The circuit of a 10MHz IF using npn, bipolar transistors is shown in Fig. 1. This unit has a gain of 55 to 65dB, a bandwidth slightly under 1MHz and a very low noise figure. (better than 3dB). It is simple, non critical and easy to construct and align.

Construction is shown in Fig. 2. The chassis may be made from tinplate, brass, copper or printed circuit boards soldered together. Ground connections may then be made by soldering directly to the chassis.

Possible instability will be considerably reduced by the installation of of a bottom shield plate thus completely enclosing the unit.

Ensure that the interstage coupling connection holes are drilled in the interstage shields before soldering them into position. It is extremely difficult, if not impossible, to do afterwards.

Fig. 3. shows an IF amplifier constructed around the Motorola integrated circuit MC1550. This circuit preceded by the BFY90 stage of Fig. 1 provides a very sensitive and easily built unit.

Alternatively, a good valve amplifier may be constructed using the circuit shown in Fig. 4. Again interstage screening needs close attention to avoid instability problems. The unit shown has a centre frequency of 30 MHz, however the addition of 150 pf capacitors in parallel with each tuned circuit will lower the frequency to 10 MHz. If widely different frequencies from these are required, it may be necessary to change Q1, Q2, L1, C2 and C3. Approximately the same gain and bandwidth are provided by this amplifier as for the transistorised unit of Fig. 1.

VHF CONVERTERS

Excellent VHF converters, covering the 52, 144 and 432 MHz bands, can be obtained through the Wireless Institute of Australia. These converters may need modification (frequency changing) to avoid interference from amateur radio transmissions, especially in areas where there are many radio amateurs.

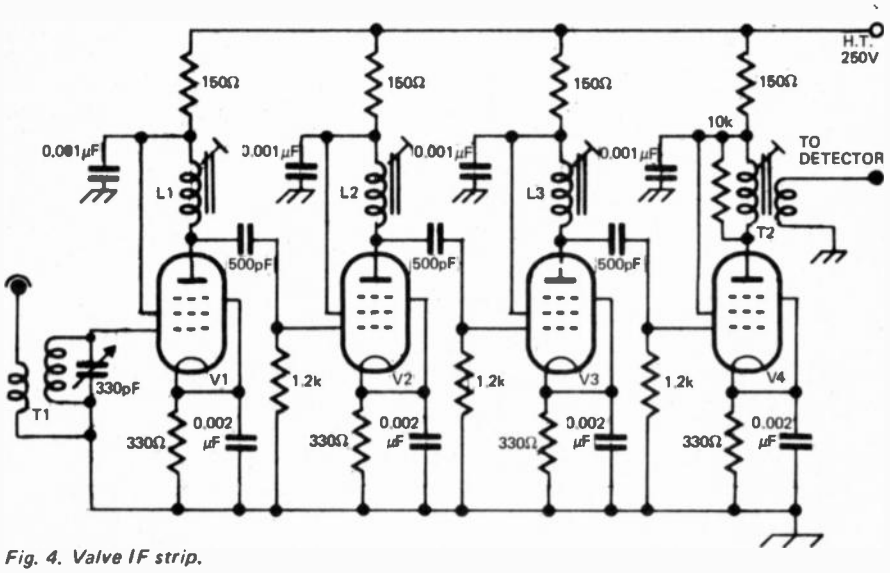


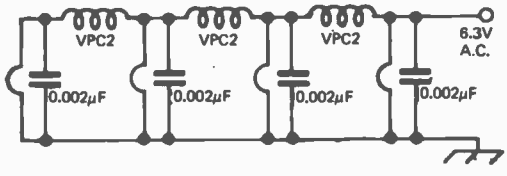
Fig. 4. Valve IF strip.

V1, V2, V3, V4 — 6AK5, 6AG5, 6B26, 6AC7, 6SK7 etc. EF50.

L1, L2, L3 — Aegis, RFT-10, unmodified.

T1 — Aegis RFT-10, secondary unmodified — primary 4 turns

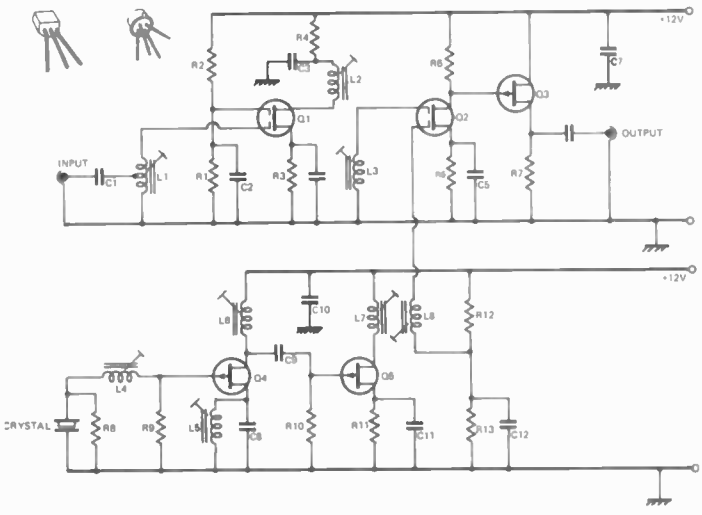
T2 — Aegis RFT-10, unmodified



RADIO ASTRONOMY FOR AMATEURS

TABLE 1

L1	9 turns (tap at 2 from earth end)	20 swg	spaced over ½"
L2	10 turns	20 swg	spaced over ½"
L3	9 turns	20 swg	spaced over ½"
L4	15 turns	28 swg	close wound
L5	20 turns	28 swg	close wound
L6	25 turns	28 swg	close wound
L7	12 turns	20 swg	close wound
L8	10 turns	20 swg	close wound



Q1 3N140, MFE3006, AO673 preferred type as gates are zener protected.
Q2 3N141
Q3, Q4, Q5 MPF102

R1 68K
R2, R9 100K
R3, R5, R7, R11 270
R4 150
R6 3-9K
R8 1K
R10 10K
R12 12K
R13 1.5K

C1, C2, C3, C4, C10, C11, C12 1000pF
C5 .01 μF
C6 .01 μF
C7 .047 μF
C8 SEE L5
C9 33pF

L1 see table
L2 see table
L3 see table
L4 .005 to .02 μH
L5 Resonate to 2/3 CRI freq.
L6 3 x CRI, 1 x CRI
L7 9 x CRI, 3 x CRI
L8 9 x CRI, 3 x CRI

USE BNC TYPE UG-1094/U INPUT & OUTPUT SOCKETS.
CRI 15.017MHZ, 13.941MHZ.

Fig. 5. This VHF converter uses field effect transistors.

Apart from their low price, these converters have very good performance, and whilst it is perfectly feasible to construct one's own unit, the commercially available units have the advantage of having all the 'bugs' sorted out.

But if you are keen on building your own from scratch, here are a few circuits.

FET VHF CONVERTER

The circuit of a very good FET VHF converter is shown in Fig. 5. This unit may be used on frequencies from HF to UHF with very good results. All the components are locally available at reasonable prices.

The tuning coils are wound on Neosid type 722/1 formers and then cemented to the printed circuit board. The tuning slugs are F29 and type 7100. Coil winding details for 140 MHz are given in Table I. Winding details for other frequencies may be obtained from the Neosid company's data.

Some precautions are necessary when locating the FET's on the printed circuit board. To avoid damage from electrostatic charges, a strand of fine wire should be wound around the leads of each FET, removing it only after they have been soldered into place. Handle the FET's by the case at all times.

The crystal oscillates at one quarter of the local oscillator injection frequency — 130 MHz for a 10 MHz IF. The crystal necessary for other combinations of signal frequency and IF can be calculated as follows:—

$$\text{crystal frequency} = \frac{\text{signal frequency} - \text{IF}}{4}$$

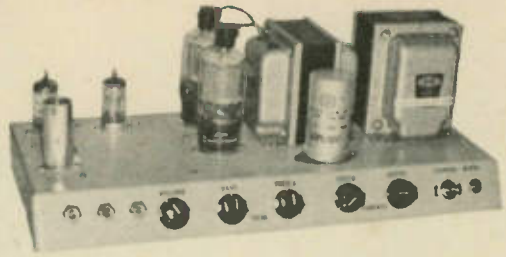
The completed unit should be enclosed in a metal box to prevent noise pick-up and IF breakthrough. Type BNC connectors should be used for input and output connections.

The performance of this unit is excellent, noise figure is approximately 3dB, bandwidth about 3MHz and sensitivity (into a good IF) is about 0.1μV for 10dB signal to noise ratio.

To be continued next month.

INSTROL

GUITAR AMPLIFIERS & GUITAR SPEAKERS



GUITAR AMPLIFIERS

INSTROL PM116 (40W)

A guitar amplifier with a power output of 40 watts RMS and full vibrato and tone control facilities, it can be used with bass, rhythm or lead guitars, electric bass or electronic organs. Alternatively, with the controls set for level response, it can doubel as a high-powered public address unit. The smplifier itself may be suited for bass, rhythm or lead guitars by simply setting the two tone controls for the desired bass/treble response contour.

Kit of Parts ..... $79.00(post $3.40)
Built/Tested ..... $99.00(freight $3.40)
Cover with handles, extra $9.93 (85c)

SEPARATE COMPONENTS

Chassis ..... $4.72 (post 75c)
Chrome foot switch housing ..... $2.15 (post 25c)
Etched label ..... $2.45 (post 20c)

INSTROL PM117 (60W)

A more elaborate version of the Playmaster 116 outlined above. Included in this design are specially "doctored" input facilities, having fixed amount of bass and treble boost, and an optional "extra treble" circuit. It has 60W RMS power output.

Kit of Parts ..... $87.00(post $3.40)
Built/Tested .... $107.00(freight $3.40)
Cover with handles, extra $9.93 (85c)

SEPARATE COMPONENTS

Chassis ..... $4.72 (post 75c)
Chrome foot switch housing ..... $2.15 (post 25c)
Etched label ..... $2.45 (post 20c)

INSTROL PM125 (50W)

A fully solid-state guitar amp. rated at a nominal 50 watts continuous power. Featuring 2 totally independent tone control channels and a fully transistorised tremelo facility, the amplifier offers unique flexibility of application in a light and compact unit.

Kit of Parts ..... $106.00 (post $3.40)

SEPARATE COMPONENTS

Metal work ..... $7.17 (post 75c)
Etched label ..... $5.09 (post 25c)
Printed Board ..... $2.91 (post 20c)

Like all Instrol kits, the guitar amplifier kits are complete in every detail down to the last nut and bolt, and precisely to specifications. Chassis is ready drilled, cadmium plated and finally passivated to avoid fingermarking. The front label is beautifully finished with black lettering on silver-white background. Kits for both the 116 and 117 include extras such as 3 inputs, vibrato and extra treble pull switches, and foot switch complete with chrome housing.

Instrol guitar speaker kits come complete with enclosure kits, grille cloth, speakers, wire screws, etc.

FUZZ BOX

This special effect unit suits all Instrol guitar amplifiers. It is housed in a small grey metal case, with two black and silver labels to enhance the overall appearance. Styled to rest on the floor near the guitarist's foot. It has a fuzz/normal switch on the sloping panel, while the combined fuzz control pot and off/on switch is on the horizontal panel.

Kit of Parts ..... $13.50 (post $1.25)
Built/Tested ..... $17.50 (post $1.25)

SEPARATE COMPONENTS

Metalwork ..... $3.87 (post 75c)
Set 2 labels ..... $1.23 (post 25c)

FREIGHT: All the above speaker systems can be sent by road transport or passenger rail. Freight would be paid on receipt of the goods.

NOTE: The speaker enclosures are available separately without the speakers. Write in for a leaflet on Instrol Guitar Speaker Enclosures.

GUITAR SPEAKERS

INSTROL G9 SYSTEM, 50w

Featuring one Rola 12U50 12in speaker in an enclosure 17½in x 17½in x 11½in. (Impedence 8 or 15 ohms). Available with enclosure kits either in unveneered pyneboard (ideal for vinyl covering) or unpolished maple veneer (ideal for estapol stain). Price complete with speaker, etc.

Pyneboard Kit $52.35
Maple Kit $57.85

INSTROL G10 SYSTEM, 60w

Featuring two Pioneer P382B 15in speakers in an enclosure 36in x 22in x 16in. (Impedance 4 or 8 ohms). Available with enclosure kits either in unveneered pyneboard (ideal for vinyl covering) or unpolished maple veneer (ideal for estapol stain). Price complete with speakers, etc.

Pyneboard Kit $93.26
Maple Kit $97.26

INSTROL G14 SYSTEM, 60w

Featuring four MSP 50294 12in speakers in an enclosure 29½in x 28in x 11 in. (Impedance 4 or 15 ohms). Available with enclosure kits either in unveneered pyneboard (ideal for vinyl covering) or unpolished maple veneer (ideal for estapol stain). Price complete with speakers, etc.

Pyneboard kit $130.61
Maple kit $135.11

INSTROL G18 SYSTEM, 100w

Featuring two Rola 12U50 12in speakers in an enclosure 33½in x 17½in x 11½in. (Impedance 4 or 8 ohms). Available with enclosure kits in either unveneered pyneboard or unpolished maple veneer. Price complete with speakers, etc.

Pyneboard Kit $100.71
Maple Kit $105.71

INSTROL
HI-FI & ELECTRONICS CENTRE
91A YORK ST., (between King & Market Sts.),
SYDNEY, N.S.W. 2000. Phone 29 4258

Please send me the following Amplifier Kitsets, and/or speaker kits. (Post is not applicable for speaker kits.)

..... at $ ..... plus post $ .....
..... at $ ..... plus post $ .....
..... at $ ..... plus post $ .....

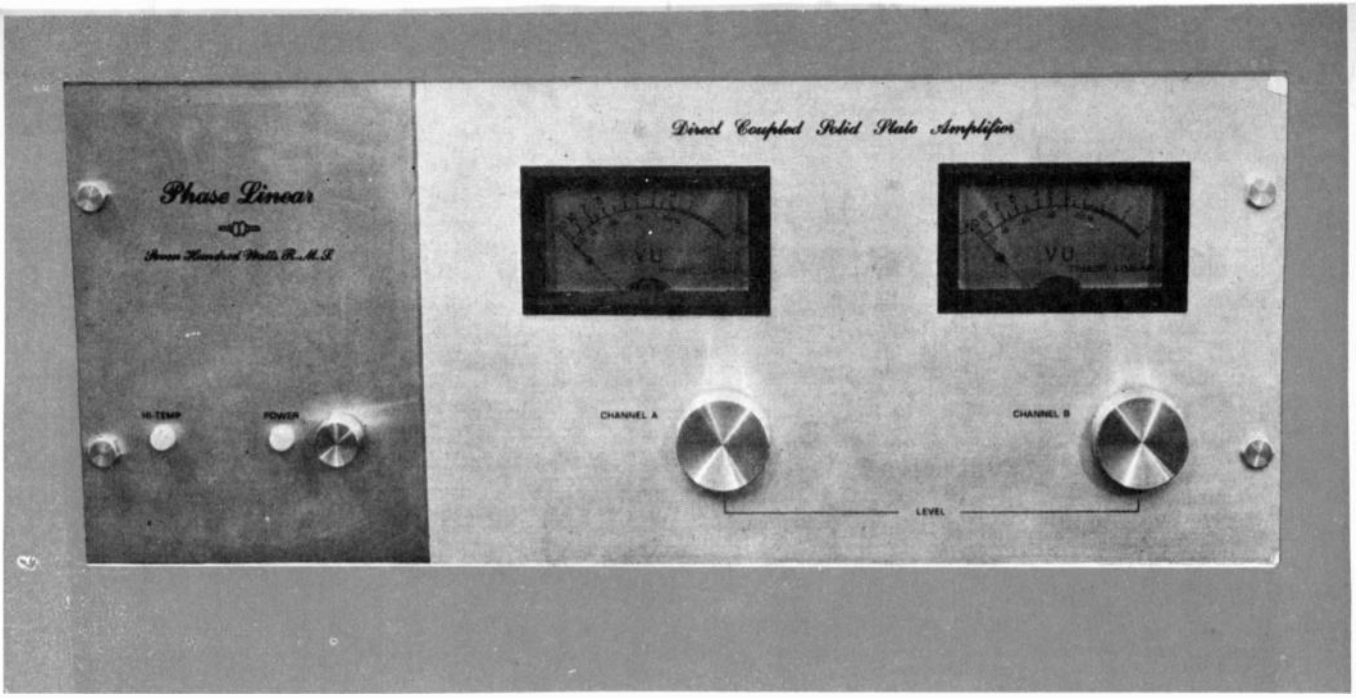
I enclose my money order/cheque for $ .....

NAME .....

ADDRESS .....

..... P.C. .....

T203



SEVEN HUNDRED WATTS!

electronics TODAY product test

"Power tends to corrupt — and absolute power corrupts absolutely". Lord Acton.

The Phase Linear Corporation has set out to produce a high-powered amplifier with a flat frequency response from dc to beyond 20 kHz, and with phase performance to match. To a large extent these aims have been achieved.

The Phase Linear amplifier meets the most exacting specifications that could be realistically required for precision audio frequency equipment in scientific or industrial applications.

It is an unusual amplifier in that it is fully dc-coupled but has facilities in-built to allow ac coupling for audio work. It is as equally suited to a servo control system as it is in a theatre or auditorium.

It is in fact a precise instrument — and really too good for hi-fi applications.

Clearly this is a very fine unit indeed — so why on earth does the company's sales division promote it with claims and statements that are either grossly exaggerated or misleading.

We quote for example "... with today's low efficiency speaker systems, a power input of *several thousand watts* would be required (dissipation allowing) to produce the sound pressure peaks that occur in live musical performances. Clearly the larger the amplifier, other things being equal, the more faithful the sound."

(It can readily be shown that an average low efficiency speaker — with an electro-acoustic efficiency of 1% to 1½% can reproduce orchestral peaks at levels comparable to concert hall experience, i.e. half an acoustic Watt, with a speaker input power of less than 50 Watts. — Ed.)

Or, "A one hundred watt amplifier is not capable of producing the sound pressure levels often demanded on any but the most efficient speaker systems.", and, "most modern high fidelity speaker systems will be able to safely accommodate the reserve power of the Phase Linear".

At best this latter statement is a half truth. There are very many speaker systems that will handle neither peak nor average powers of the magnitude suggested. Seven hundred watts into the average horn loaded speaker, or small bass reflex unit, would project the voice coil practically into lunar orbit.

The statement also completely ignores the transient power capabilities of most amplifiers.

Even a pair of Bose speakers can get by very nicely indeed with a lot less than 700 watts.

But if Phase Linear say that you can use this much power — the least we felt we could do was to try — nevertheless 700 watts is 700 watts is 700 watts, so instead of using speakers of high electro-acoustic efficiency we chose four Bose units — two paralleled in each channel to absorb the power.

The testing equipment consisted of a Kudelski Nagra BH3 tape recorder with pre-recorded tapes, a Pioneer SC700 pre-amplifier together with the

We would like to make it completely clear that our criticisms of the Phase Linear promotional material applies to that material supplied with the amplifier and published in the USA.

Bose equaliser, the Phase Linear 700 amplifier and four Bose speakers – all set up in the open against our laboratory wall.

EXPLOSIVE

The results can only be described as explosive. Ten feet away, the *average* sound pressure level exceeded 108 dB, with peaks of over 116 dB. At one hundred and fifty feet, and at 90° to the axis of the speakers, the level exceeded 96 dB. The level was literally deafening, and in fact our ears were unable to evaluate the quality of reproduction. Only by using ear plugs could any degree of pleasure be obtained.

Even with very low efficiency speakers the sound levels that could be obtained were awe inspiring. (remember that peaks of 116 dB correspond to 100 times the sound level of a full symphony orchestra with all members playing flat out.)

We had intended to try this system in our reverberant chamber, but were spared the agony of music at 125 dB plus by the timely demise of our spare fuses. What it must be like in an enclosed room with medium or high efficiency speakers is difficult to imagine.

If the Phase Linear sales people are serious we must only assume that as far as amplifiers are concerned, some Americans have gone totally power mad; and this device is the latest manifestation of their mania.

And this is all a great pity because despite all their sales nonsense this really is a very fine amplifier indeed.

THE CONSTRUCTION

The construction of the amplifier is massive and could almost be described as a group of transistor heat sinks and a transformer attached to a 19" panel.

Whilst this may seem an oversimplification, the remaining components make up less than 10% of the total weight and take up less than 30% of the total volume.

The frontal appearance is simple and business like. The brush-satin aluminium rack panel is divided into two sections. The lefthand end is engraved with the Phase Linear name and contains two bezel lights, one being the high temperature overload light, and the other the power light next to its rotary on/off power switch.

The main part of the panel is taken up by two large illuminated V.U. Meters with two large polished aluminium level controls cum attenuator knobs set below them.

A very large power transformer lies behind the left hand end of the front panel, whilst the main circuitry-mounted on a large printed circuit board – is located behind the V.U. meters in a well ventilated enclosure.

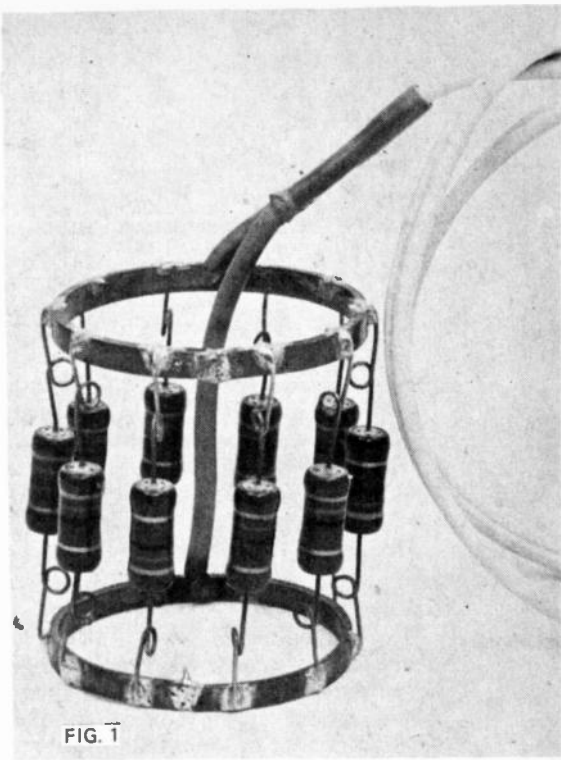
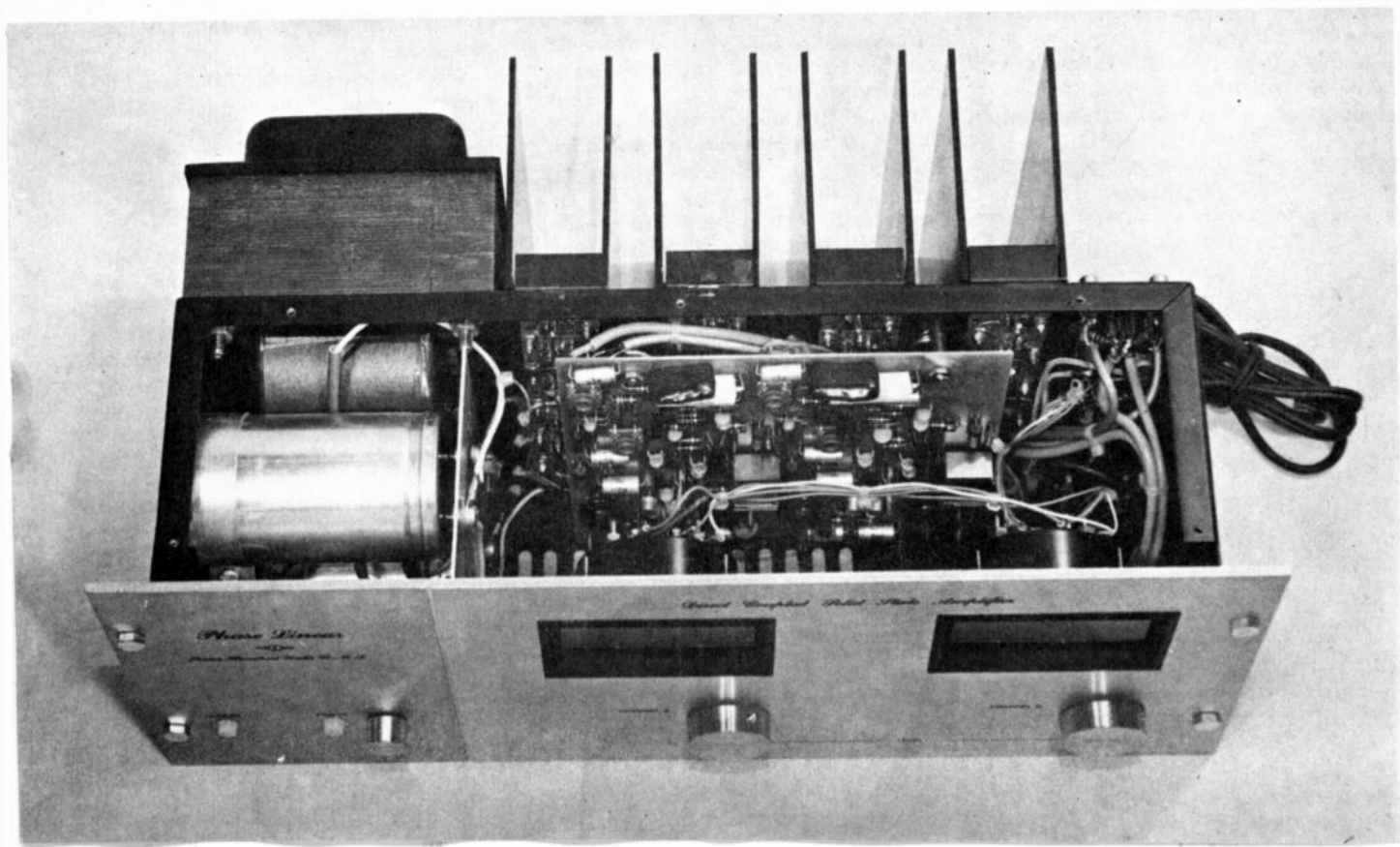


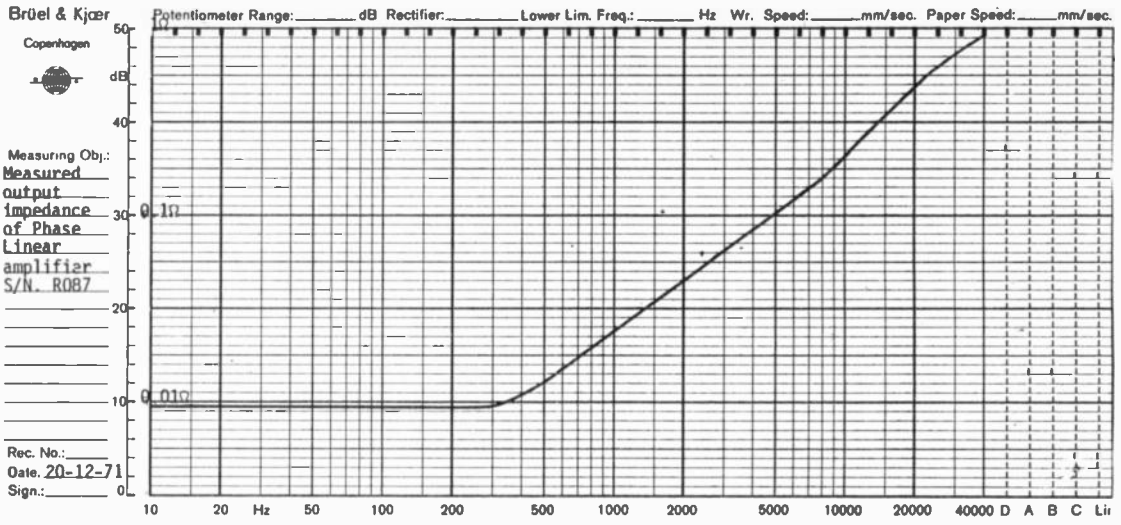
FIG. 1

The circuitry is fairly conventional and consists of a series of long-tail pairs used to drive a single-ended push-pull stage with five npn silicon power-transistors in parallel in each set of the positive and negative push-pull elements.

The designer has taken special care to protect the amplifier against thermal runaway and has interlocked the primary supply through a thermal relay of which the control circuitry is



SEVEN HUNDRED WATTS!



not shown on the circuit diagram supplied.

The components are all of professional quality and the construction is far better than one would expect from looking at the drafting quality of the circuit diagram in the service manual.

The back of the amplifier has all input and outputs on the extreme lefthand end (viewed from the rear) with the four large double fin heat sinks in the middle and flanked by the power transformer on the right.

Inputs consist of four RCA coaxial sockets at the top of the panel. Two of these inputs are for ac inputs and two are for dc inputs. A switch selects the inputs required.

The dc inputs must never be used for audio work, for low frequency transients would cause cone excursions that would drive the speaker diaphragms out of their frames. Fortunately the handbook clearly warns of this danger.

The outputs are located immediately below the inputs and consist of four colour-coded universal terminals suitable for wire terminations or banana plugs.

At the bottom of the panel are five fuse holders, one for the mains and four 5 amp fuses for the dc supply rails.

The heat sinks are ten gauge aluminium channels having fin dimensions of 6½" x 4¾". However despite this, the cooling area of each sink falls far short of that required for the dissipation of 700 watts of power. Because of this the manufacturers recommend the use of a cooling fan for extended high power operation. Without a fan we found the output power was limited to under 200 watts in an air-conditioned room with normal convection cooling.

With moderate volumes of air from a small fan placed under the amplifier, it was possible safely to dissipate the heat with an output of 700 watts of continuous power into a resistive load.

This sort of operation is of course, unusual and would not normally be expected except at a rock concert or under industrial use.

Although the manufacturer could be critized for not supplying a cooling fan this would be unfair as the type of fan and air flow capacity would be determined primarily by the amplifier's location and the air flow restrictions produced by its enclosure.

TESTING 700 WATTS

The task of performing instrumental measurements on an amplifier nominally three times more powerful than any we had measured before, presented a number of problems. Our first was that our precision dummy loads were not designed for more than 100 watts of continuous dissipation. These use, or should I say, used to use, 10 Corning Electrosil resistors (type TR8, 1 watt) in parallel (figure 1). And whilst these work quite happily in a bucket of water at 100 watts input, they complained at 350 watts, and at 400 watts they failed. It is a credit to their manufacturer that the resistors could stand 300 watts of continuous power for this is equal to 30 watts per resistor.

The load problem was eventually solved when we found that we could drive either a small radiator or a number of large light bulbs up to quite high frequency. A Variac intersposed between the amplifier and load enabled us to control power dissipation.

The remainder of the testing proved to be a simple task for the parameters of the Phase Linear amplifier are basically as stated by the manufacturer.

First of all the average continuous power with fan cooling into 8 ohm loads is 350 watts into each channel (making a total of 700 watts, and into 4 ohms, 600 watts into each channel). Under these conditions any transient occurring on either the supply or load side will cause the fuses to blow, and copious supplies of cooling air are required.

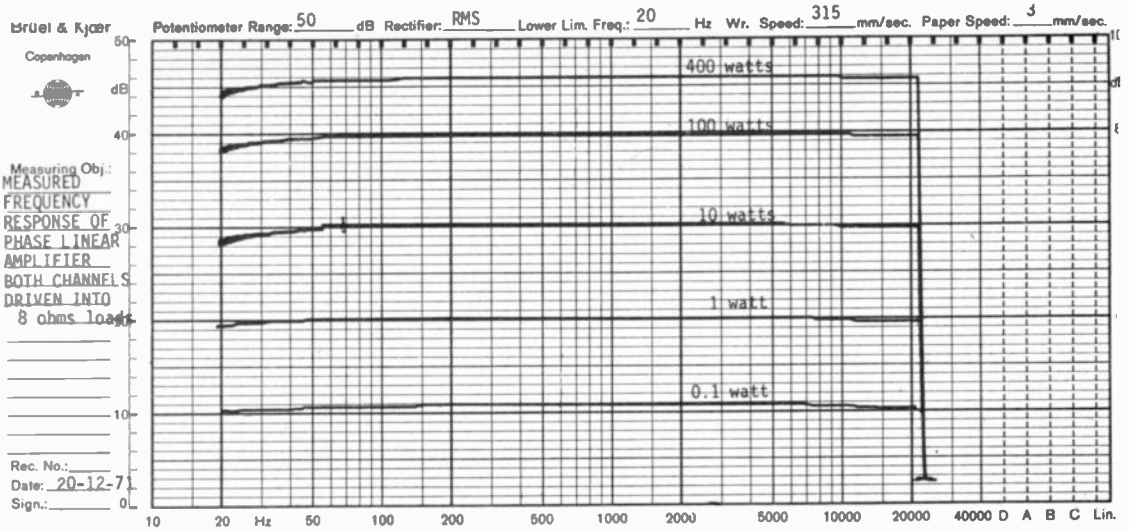
Whilst the manufacturer quotes power at clipping, as 450 watts/channel, this figure seems irrelevent for an amplifier that is intended for high quality work. Apart from this we were running out of precision load resistor banks!

Since this amplifier is very well suited to control applications, we decided to check out its phase response (the reason for the name Phase Linear). We found that because of its extremely flat frequency response in the dc mode, there is only a 10 degree lag at 20kHz. Between dc and 10kHz, its performance is extremely good, the phase shift going from zero degrees to approximately five degrees lag at 10kHz.

The manufacturers (or probably the sales division) of the Phase Linear amplifier, claim to have a patented 'computer' built in to maintain the output within specification. The description of how this works is very non-specific in the handbooks

MEASURED PERFORMANCE OF PHASE LINEAR AMPLIFIER SERIAL NO: R 087

Frequency Response
20Hz to 20kHz ± ½dB
Phase Shift
0° at 20Hz
5° lagging at 16kHz
10° lagging at 20kHz
Total Harmonic Distortion at rated continuous output of 350W (both channels loaded)
100Hz 0.20%
1kHz 0.15%
6.3kHz 0.15%
Input Sensitivity for rated output of 350W — 1.12V
Hum and Noise re rated output of 350W —96dB
Continuous Power Output (with cooling fan)
350 Watts into 8 ohms (both channels driven)
400 Watts into 8 ohms (one channel driven)
Dimensions
19" Wide x 7½" High x 10" Deep
Weight
45 lbs
Price — recommended retail price $1185.



provided. It would appear that the computer uses one transistor with information fed back from various parts of the circuit. It is intended, apparently to limit the maximum power output, any common mode operation of the two quasi – complimentary sections of the amplifier, and the maximum current output (dc or ac). Should any of these parameters be exceeded, the base of the first transistor in the driving stage is earthed.

As far as we were able to test, this circuit appears to work satisfactorily. The description of its operation is, however, grossly overstated and presumably not written by the design engineer.

Thermal cutouts are provided adjacent to the power transistors to protect them from excessive temperatures. Phase Linear recommend that if a thermal overload should cause the amplifier to trip out, the amplifier should be switched off for a few minutes to protect the thermal switches from the high transient currents which occur during switch-on. We had a look at the switches and could see why this was recommended. The switches were very small and would not withstand repeated operation for many thousands of switchings.

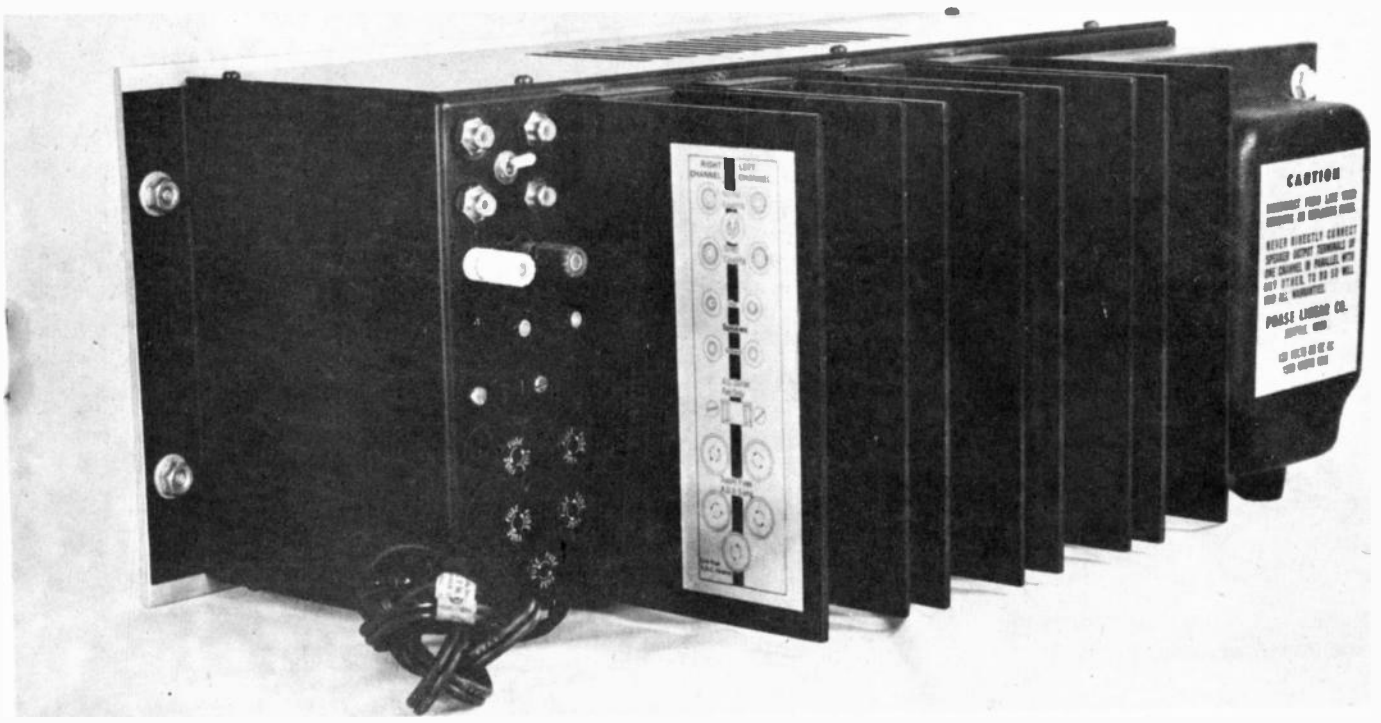
We did, however, decide to try them out over a period of several hours with the cooling fins covered and the amplifier running at about 50% of the rated output from each channel. The result was that after some 10 minutes, the amplifier switched off for a couple of minutes, turned on for about half a minute and then switched off again. After four hours of this abuse, the thermal switches were still operating correctly.

The power supply used in the Phase Linear 700 is very simple, and based on a nicely over-specified transformer that looks as if it could deliver about 1.5 kilowatts continously. This transformer feeds a bridge rectifier that supplies positive and negative 100 volt rails. The outputs are filtered by two 9800 mfd electrolytic capacitors.

At first sight such a simple power supply would seem inadequate, but since the voltage gain of the power amplifier stage is only unity, the degree of regulation required is not very critical.

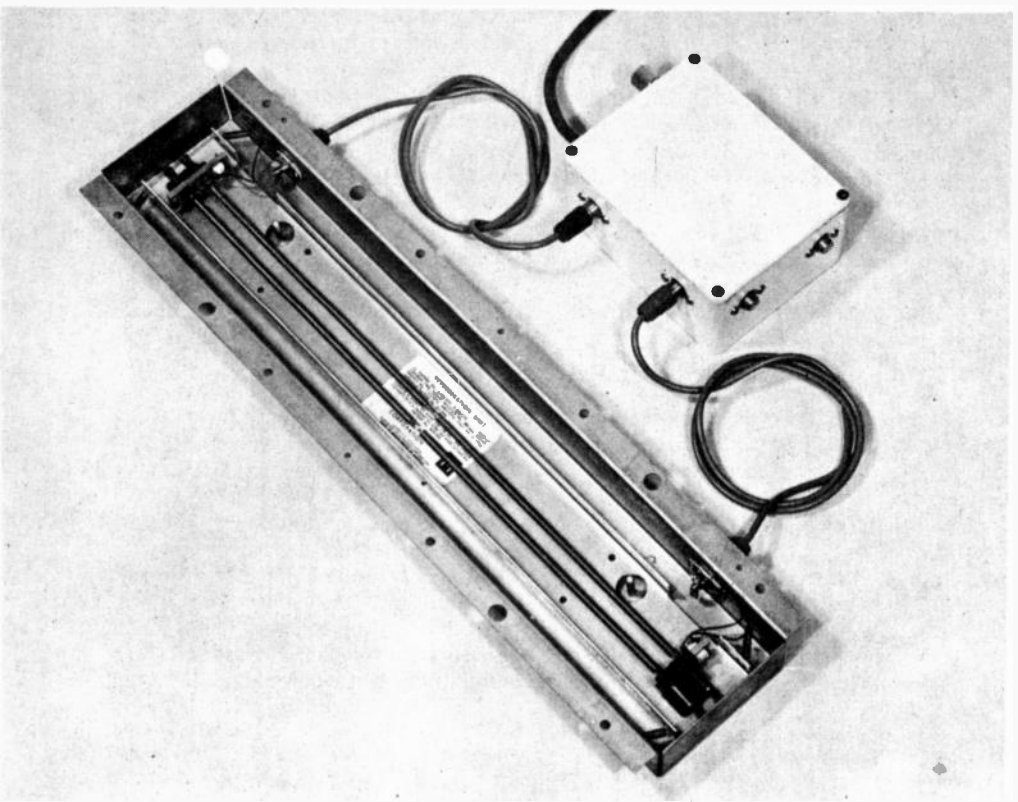
Apart from the astonishingly bad sales literature, our only real criticism of the Phase Linear amplifier is the untidy and limited nature of the (preliminary) handbook supplied. It is to be hoped that when the production handbook is released, the information in it is presented in a more useful and lucid manner.

The best way to describe the Phase Linear 700 amplifier is that is is a precision instrument capable of many scientific and industrial uses, but promoted and priced so that a deaf audiophile with a pair of Bose speakers would consider it a bargain. ●



Spring reverberation unit

This spring reverberation unit is based on readily available components.



The sound of many musical instruments can be "enhanced" by the addition of reverberation. Reverberation, added with discretion, gives life and brilliance to music which may otherwise appear dull and flat.

Reverberation is defined as the persistance of sound within an enclosure after the original sound has ceased. Reverberation may also be considered as a series of multiple echoes, decreasing in intensity, so closely spaced in time as to merge into a single continuous sound eventually dying away to nothing.

Artificial reverberation can be achieved in several ways. One system employs echo chambers to achieve the delay. A second system employs magnetic tape loop techniques whilst a third, the one employed in our project, uses an amplifier that drives springs to provide the delay. It is also possible to achieve delay by fully electronic means but for normal

ET PROJECT 408

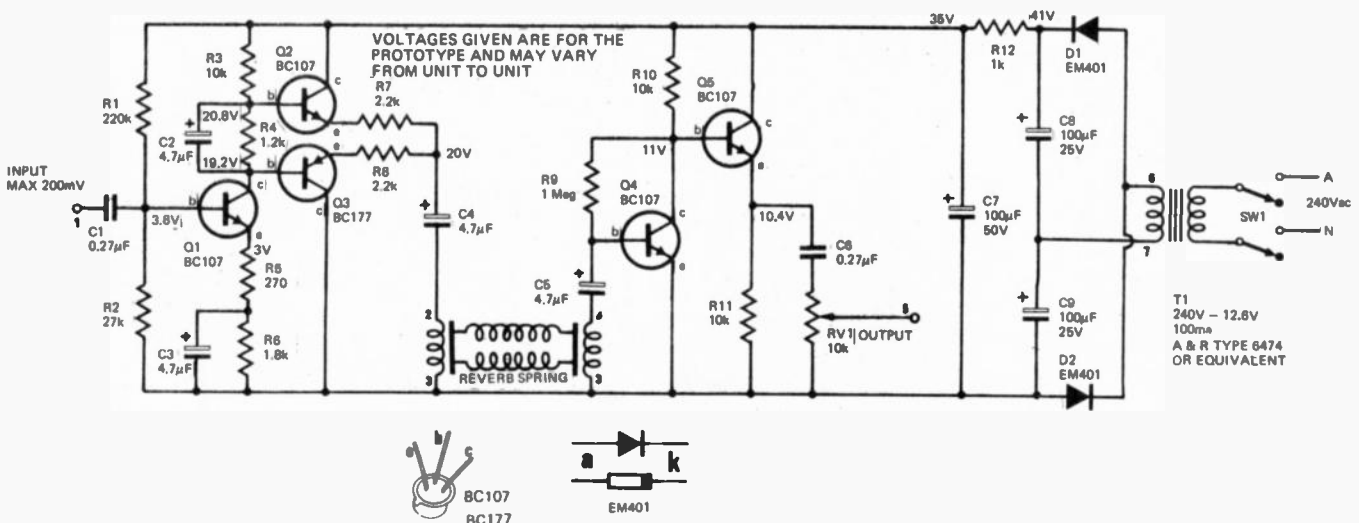


Fig. 1. Circuit diagram of complete unit.

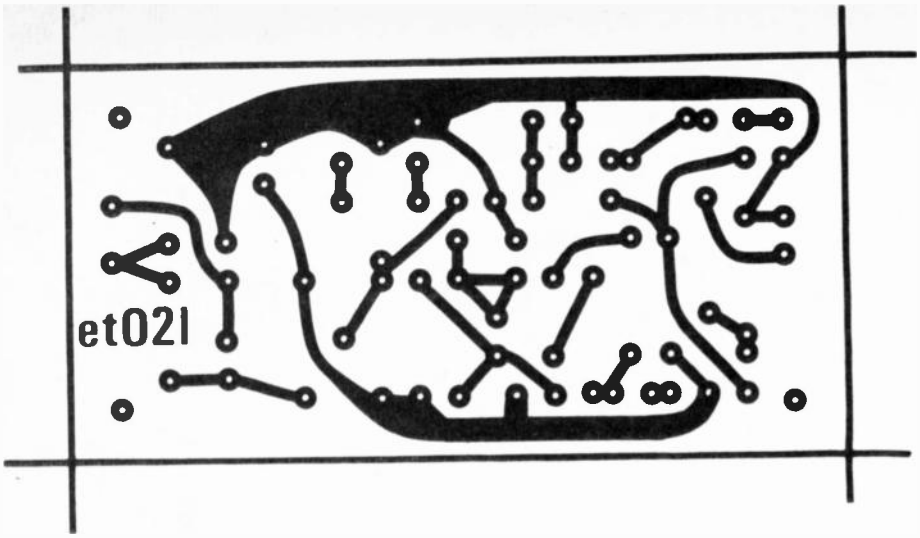


Fig. 2. Foil pattern of the printed circuit board – reproduced full size.

PARTS LIST ET408

R1 resistor 220k 5% ½W
R2 resistor 27k " "
R3 resistor 10k " "
R4 resistor 1.2k " "
R5 resistor 270 " "
R6 resistor 1.8k " "
R7 resistor 2.2k " "
R8 resistor 2.2k " "
R9 resistor 1 Meg " "
R10 resistor 10k " "
R11 resistor 10k " "
R12 resistor 1k " "
RV1 potentiometer 10k log with double pole switch
C1 capacitor 0.27 µF 100V Elna Greencap or Equiv.
C2 capacitor 4.7 µF 25V Elna Type RB or Equiv.
C3 capacitor4.7 µF " " " " "
C4 capacitor 4.7 µF " " " " "
C5 capacitor 4.7 µF " " " " "
C6 capacitor 0.27 µF 100V Elna Greencap or Equiv.
C7 capacitor 100 µF 50V Elna Type RB or Equiv.
C8 capacitor 100 µF 25V Elna Type RB or Equiv.
C9 capacitor 100 µF 25V Elna Type RB or Equiv.
Q1 transistor BC107 or Equiv.
Q2 transistor BC107 or Equiv.
Q3 transistor BC177 or Equiv.
Q4 transistor BC107 or Equiv.
Q5 transistor BC107 or Equiv.
D1 diode EM401
D2 diode EM401
T1 transformer A&R Type 6474 or Equiv.
PC Board ET 021
Reverb. springs unit Plessey Rola Type 4c on similar
metal box Eddystone type 6908P
RCA sockets
Rubber grommet
3 core flex
3 pin plug

HOW IT WORKS

The input signal (maximum level 200mV) is fed via C1 to the base of amplifier transistor Q1. The gain of the stage is determined by the ratio of R3 to the series combination of the base – emitter resistance of Q1 (about 30 ohms) and R5. This ratio is 10,000 to (30 + 270) thus providing a gain of approximately 30. The operating conditions of Q1 are set by R1, R2 and R6. Resistor R6 is bypassed by C3 so that the ac gain of the stage is not affected.

The output of Q1 is fed to complimentary output transistors Q2 and Q3. Correct bias for these transistors is determined by the 1.6 volts developed across resistor R4. Resistor R4 is bypassed by C4 so that both transistors receive identical ac signals.

Resistors R7 and R8 limit the bias current in the transistors and also determine the output impedance of the stage. The output is coupled via C4 to the drive transducer of the spring reverberation unit. The ac signal applied to the spring unit is transmitted via the spring motion to a second transducer. The 2mV signal from the spring unit output transducer is further amplified by Q4 and then dc coupled to emitter follower Q5. The amplification provided compensates for the apprroximately 40 dB loss of the spring unit to give unity system gain.

The ac component of the signal is passed via C6 to RV1 the output level control.

The unit is powered by voltage doubling the 12.6 volt secondary of T1 (15 volts unloaded) by D1, D2, C8 and C9, and then smoothing this further by R12 and C7. This results in a 35 volt supply to the amplifier transistors.

instrumental use the circuitry is prohibitively complex and expensive.

The unit described is based on a readily available spring reverberation unit and is intended to be incorporated into an existing instrument amplifier system.

Mounting details are not provided as these will vary according to the construction of the basic equipment. The unit should be interposed between the pre-amplifier and the main amplifier, but cannot be driven directly from a microphone as the impedance mismatch and hum pickup will considerably deteriorate performance.

CONSTRUCTION

The unit is constructed on a printed circuit board, the foil pattern for which is shown in Fig. 2. Component location and orientation are shown in Figures 3 and 4. Particular attention should be paid to inserting components the right way round.

Our unit is pictured built into a diecast box, but as previously mentioned this is not necessary if it is to be built into the instrument amplifier.

All components with the exception of RV1, SW1 and the power transformer are mounted on the printed circuit board. If desired RV1 and SW1 may be a combined switch-potentiometer, but a separate power switch is preferable as it allows the unit to be left set up with a pre-determined reverberation level.

Remember to keep audio wiring away from wires carrying 240 volt mains where possible. For short audio runs twisted pair may be used, but for longer runs, shielded insulated cable is recommended.

Should a dc supply of greater than 35 volts be available from the instrument amplifier, this may be used in place of the built in supply. Delete the transformer and voltage doubler components but retain R12 and C7.

Spring reverberation unit

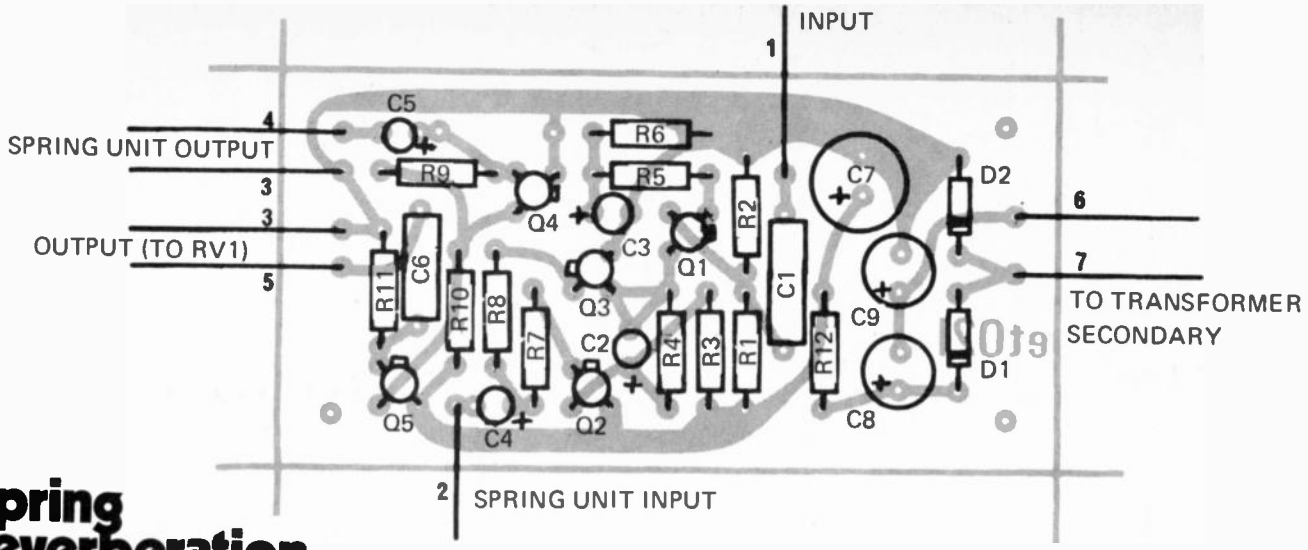


Fig. 4. Component layout

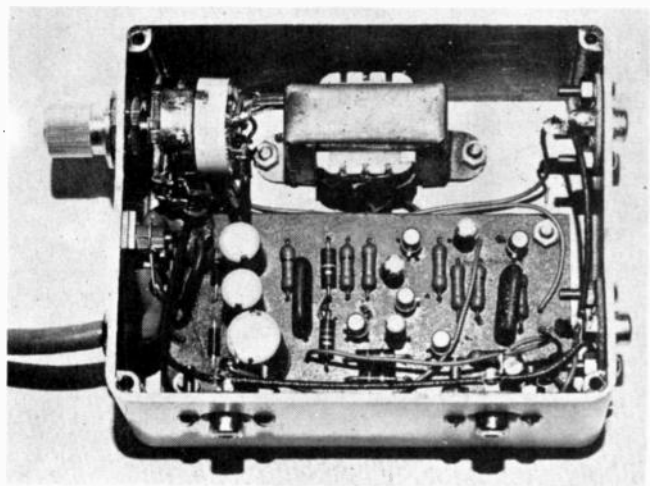


Fig. 3.

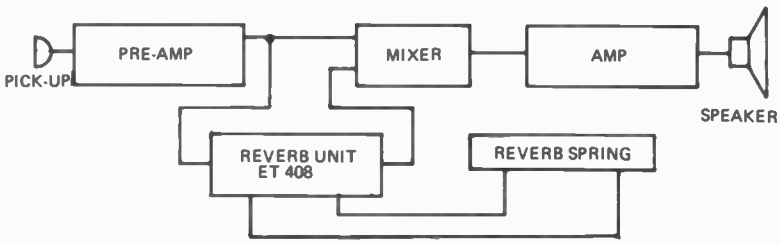


Fig. 5. How the reverb. unit is used.

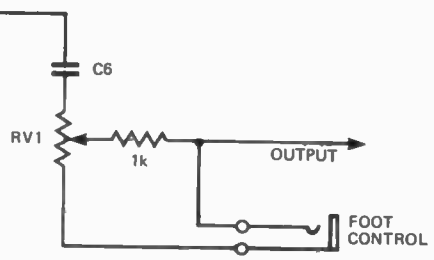


Fig. 6. This shows how a foot control may be added to the circuit.

Current consumption of the unit is 6mA and R12 should be adjusted in value to obtain 35 volts for the unit.

The value of the required resistor will be:–

$$R12 = \frac{(\text{dc available} - 35)\ 1000}{6} \text{ ohms.}$$

USING THE REVERB UNIT

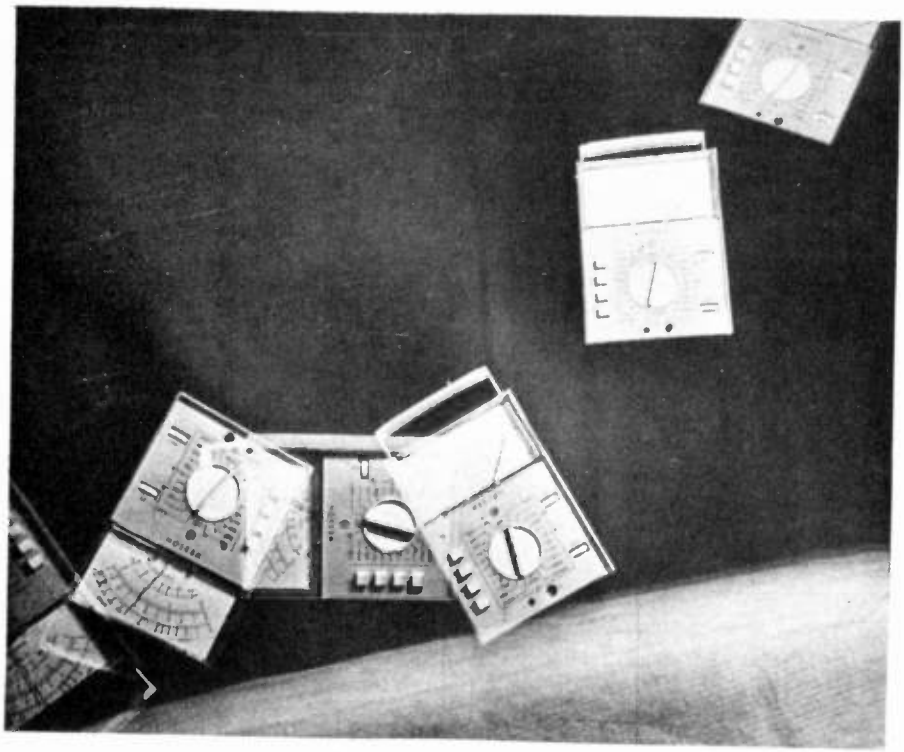
The output of the reverb unit and the output of the instrument pre-amplifier should be fed to an audio mixer such as the one for which constructional details were provided in the ET Sept 71 issue. The mixed signals can then be fed directly to the power amplifier. Where such a mixer with built in level controls is used, RV1 may be omitted and the output taken directly from C6.

A foot switch may be used to break the reverb line to the mixer where on/off control is required.

It must be kept in mind that any mechanical vibration of the spring unit will appear as an audio output. Therefore the unit should not be placed on top of speaker cabinets etc otherwise acoustic feedback will occur, with ear shattering results. ●

DROP-PROOF MULTIMETER

Weston claim their 660 Series VOM to be drop-proof — we took them at their word — here's how it performed.



The firm of Weston Instruments Inc. are well known in the electrical and electronics industries as manufacturers of precision instrumentation. Weston were one of the pioneers of the basic D'Arsonval moving coil meter movement and over the years have continually improved the design. One of their most recent developments is the drop-proof taut-band meter movement used in the Model 666 V.O.M.

The Weston 660 series meters are available in five basic versions, all housed in the same drop-proof, blue-grey, polycarbonate case. This case has a raised front panel edge to protect the meter face and front panel controls. The snap-on range plate is reverse engraved in black with a light grey background. The range switch push buttons and calibration potentiometer knobs are made from white plastic. These harmonise well with the blue-grey housing, and light grey range plate.

THE 660 SERIES METERS

The 660 series meters have a broad range of sensitivities and optional

MEASUREO PERFORMANCE OF WESTON MOOEL 666 V.O.M. METER SERIAL NO 83804

D.C. CURRENT

Selected Range	Input Current	Meter Reading
30 mA	29.9 mA	30 mA
	9.99 mA	10 mA
10 mA	9.95 mA	10 mA
1 mA	1.00 mA	1 mA
	0.900 mA	0.9 mA
	0.800 mA	0.8 mA
	0.710 mA	0.7 mA
	0.610 mA	0.6 mA
	0.500 mA	0.5 mA
	0.410 mA	0.4 mA
	0.300 mA	0.3 mA
	0.210 mA	0.2 mA
	0.104 mA	0.1 mA
100 μ A	100.4 μ A	100 μA
10 μ A	10.1 μ A	10 μA
1 μ A	1.00μ A	1 μA

A.C. CURRENT

Linear From 50Hz to 20,000 Hz ± 1%

Selected Range	Input Current	Meter Reading
30 mA	30.0 mA	30 mA
10 mA	9.97 mA	10 mA
1 mA	1.01 mA	1 mA
100 μ A	101 μA	100 μA
10 μ A	10.1μA	10 μA
1 μ A	1.00 μA	1 μA

A.C. VOLTAGE at 100 Hz

Selected Range	Input Voltage	Meter Reading
1000 V	1000 V	1000 V
300 V	300 V	300 V
100 V	100 V	100 V
30 V	30.0 V	30 V
10 V	10.0 V	10 V
3 V	3.00 V	3 V
1 V	1.01 V	1 V
0.3 V	0.300 V	0.3 V
0.1 V	0.100 V	0.1 V

D. C. VOLTAGE

Selected Range	Input Voltage	Meter Reading
1000 V	1001 V	1000 V

Selected Range	Inpu
300 V	30
100 V	10
30 V	3
10 V	1
3 V	
1 V	
0.3 V	
0.1 V	

dB SCALE

Selected Range	Atte
0 dB	0 dB
	-1
	-2
	-3
	-4
	-5
	-6
	-7
	-8
	-9
	-10
	-12

"Consider that men will do the same things nevertheless, even though thou shouldst burst"

– Marcus Aurelius Antoninus.

electronics TODAY product test

features. The first of these, the model 660 has the following ranges:–

DC volts – 5 mV to 5000 V
AC volts – .05 V to 5000 V
DC amps – 1μA to 10A
Ohms – ½Ω to 20 M Ω
dB scales – -10dB to +56dB

The required range is selected by a large centrally located white knob and by use of the correct probe socket (total of seven). The instrument has a claimed accuracy of 2% on dc and 3% on ac ranges and is basically a passive multimeter.

The Model 662 V.O.M. features the same ranges and accuracy as the 660 but is also fully protected by a resettable relay type of overload circuit.

The models 661 and 663 are higher accuracy versions of the 660 and 662 (respectively). They have the same basic ranges with accuracies of 1% on dc and 2% on ac.

The only noticeable external difference between the 661 and 663 is the mirrored strip on the 663 meter scale.

The Model 666 reviewed in this article is completely different from those mentioned above in that it is an active, solid state multimeter specifically designed for the electronics industry.

THE MODEL 666

The Model 666 has four clearly labelled push buttons located on the lefthand side of the front panel. These provide the following meter mode selections:–

The top button labelled "AC" is for ac voltage, ac current and decibel measurements (reference 1dBm or 1 milliwatt into 600 ohms).

A second button labelled "ΩLV" programmes the instrument for resistance measurement by the application of a very low voltage (85 millivolts open circuit). This facility is invaluable for checking resistors in semiconductor circuitry, and for the measurement of low wattage, low value resistors.

The third button is labelled "DC – Ω" and is used for reversed dc measurements, or resistance measurements with the test voltage polarity reversed.

The last button is labelled "DC + Ω" and is used for conventional polarity dc measurements, or resistance measurements with the test voltage conforming to the test probe polarity.

A large range selector knob is located in the centre of the snap-on range plate. The "off" position is in the twelve o'clock position. The selectable ranges are shown in Table I on page 67.

The "zero" and "infinity" set potentiometer thumbwheels are located at the righthand side of the range knob and provide smooth and adequate control within the normal range of battery operating voltage.

Another in the Weston 660 range, this 662 VOM features passive circuitry. It has the same 'droppable' characteristic of all the 660 range of instruments.

METER SCALES

The meter dial, which is approximately 4" x 2", has five graduated scales. The top scale, for resistance measurements, is graduated from 0 to 1k.

The next scale is for both voltage and current measurements and is graduated from zero to 1 for use on ranges that have full scale readings that are multiples of ten.

The third scale is for both voltage and current measurements and is graduated from zero to 3 for use on ranges which have full scale readings that are multiples of three. The second last scale is graduated from –20 to +2dB.

The bottom scale, which is for null

Voltage	Meter Reading
V	300 V
V	100 V
2 V	30 V
7 V	10 V
2 V	3 V
1 V	1 V
00 V	0.3 V
00 V	0.1 V

ator Step	Meter Reading
	0 dB
	-1.0
	-2.1
	-3.1
	-4.4
	-5.2
	-6.2
	-7.3
	-8.3
	-9.4
	-10.5
	-12.5

Selected Range	Attenuator Step	Meter Reading
	-14	-15
	-16	-17
	-18	-19
	-20	-21

The -10 dB, +10 dB and +30 dB scales are accurate throughout the entire scale.
The -20 dB, +20 dB and +40 dB scales have the same reading errors as the 0 dB scale shown previously.

OHMS

Selected Range	Source Resistance	Meter Reading
X 1 L.V.	300.0	400
	99.98	50
	3.000	2.95
	0.9998	1.00
X 10 L.V.	9998	10,000
	3000	4,000
	1000	1,000
	300.0	300
	99.98	99

Selected Range	Source	Meter Reading
	30.00	29.5
	9.998	9.8
X 100	9,998	10,000
	3,000.5	3,050
	1,000	1,050
	300.0	300
	99.98	100
X 1000	9,998	10,050
	3,000.5	3,000
	1,000	1,000
X 10,000	9,998	10,000
X 10k	989,700	1×10^6
X 100k	989,700	1×10^6
X 1m	989,700	1×10^6

POTENTIOMETERS

STANDARD (log or 1in.): 38c each.
SWITCH (log or 1in.): 75c each.
DUAL GANG (log or 1in.): $1.45 ea.
RANGE 1K-2M. All 2in. shafts.

RESISTORS (± 5%)

¼ and ½W., 4c each or $3.00 per 100.
1W., 7c each, or $5.50 per 100.
Your selection between 1 ohm. and 10 m.

RESISTOR PACK

Pack 56: Contains 3 resistors of the 57 values between 10 ohms. and 1 m. totalling 171. All carbon film 5%. ¼W. $4.75, ½W. $4.84.

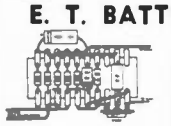
MARCH SPECIALS

BC109, 10 for $3.70
EM401, 10 for $2.20
EM404, 10 for $2.20
2N3055, 2 for $3.10
Crystal Earp'ce w/cord 55c
Ferrite Rods 8"x3/8" 55c
.001uF Feed Thru caps 26c
Black knob 1" long w/chrome 10c
NE2 neons 18c
3.5mm plugs 15c
6.5mm plugs—metal 39c
Quality: All above items are new and guaranteed by manufacturer.

RELAYS

Top grade Siemans type, 6-12V. coil. Single changeover contacts. Miniature in size, these relays are capable of switching 240V. A.C. @ 7.5A cont. Price: $2.50 plus 30c post.

E. T. BATTERY SAVERS



ET511A
An excellent regulated supply for 4.5-9V. @ 250 mA. Price $4.51 plus 30c post.

ET511B
A full power supply inc. Transformer and Regulator. Price: $8.95 plus 75c post.

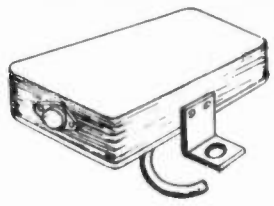
AUTOMATIC CAR THEFT ALARM KIT

See Jan. E.T. for full details. Complete kit inc. a Diecast Box in which to house the unit.
$24.50 plus 50c post.

S.C.R. SPEED CONTROL KIT

Will vary the speed of electric drills, saws, food mixers, movie projectors, etc., etc. Gives a wide range of speeds while maintaining maximum torque. Complete kit inc. diecast box & full instructions supplied. PRICE $13.90 + 75c post. (Will operate motors to 750W)

C.D.I. KIT $21.50 plus $1.00 post

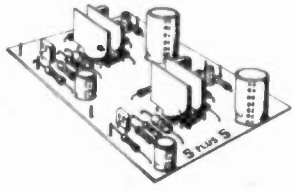


Complete to last item including prewound secondary winding on transformer. Suits all 12V systems, negative or positive earth. This system improves fuel consumption, points & plugs life, easier starting, etc. All parts guaranteed. Ideal gift suggestion.
WIRED & TESTED $29.50 plus $1.00 post. KIT-FORM $21.50 plus $1.00 post.

QUALITY

We only stock new and guaranteed components — no disposals or second hand goods. Our policy is to supply only top grade parts at best prices in Australia. You can buy with confidence.

5 + 5 STEREO AMP



Power: 5W R.M.S. Per Ch.
Freq. Res: 30Hz-100KHz.
Distortion: Less than 0.6%.
Sensitivity: 180mV.
Output Impedance: 8 ohms.
Supply Volts: 28V.
Complete Audio Amp modules now available using the G.E. PA263 I.C. Included in kit is the P.C. board, I.C. & all necessary parts to make up this high quality amplifier. Full instruction booklet & circuits provided.
MONO: **$7.85** + 30c Post. WIRED: **$8.85** + 30c Post
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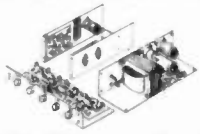

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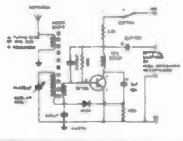

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0.0056	..	12c	0.1	..	19c
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DROP-PROOF MULTIMETER

detection is centrally located and approximately ½" long. The centre stroke is marked "O". Left and right extremities are marked minus and plus respectively. This scale may be used on the 0.1, 1.0, 10, 100 and 1000 volts dc ranges allowing null balancing to within 2% on these ranges. A scale to the right of this null scale indicates the acceptable battery voltage when the battery test position is selected.

CONSTRUCTION

The probe sockets are located at the bottom of the range plate and accept standard banana plugs. A 2 amp 240V fuse, which protects the input, is changed by removing the socket with a 3/16" Allen key (or the rear battery cover retaining screw). A retractable plastic carrying handle is fitted to the top of the meter. The back cover is retained at the top end by two lugs and at the bottom end by a screw which also doubles as an Allen key for removal of the front fuse. Removal of this cover reveals the five batteries and the three printed circuit boards.

The circuit basically consists of a dual FET source follower input stage driving an IC operational amplifier. The major advantage of the dual FET input stage is the constant input impedance of 10 megohms irrespective of range selected.

When the source impedance of a measured voltage approaches the input impedance of a meter, serious measurement errors are introduced (equal impedances give 50% error). The constant 10 megohm input impedance of the 666 therefore allows much more accurate measurements to be made on its low ranges than is possible with a passive multimeter. This high input impedance is maintained on the ac ranges thus making the meter superior in this respect to the average VTVM.

Four "AA" size cells provide power for the FET and operational amplifier stages and a further size "D" cell is used as a current source for resistance measurements. The condition of the "AA" cells is monitored by switching to the battery check position.

No hook up wire is used for connection within the meter. This unusual, but very practical feature, ensures utmost reliability. The instrument is built onto three printed circuit boards. The push button switches are mounted directly onto a sub-board into which two other larger pc boards plug. Two sections of the five wafer function switch are mounted on the 'inner' of these two boards, and the remaining three sections on the 'outer'. All other connections, battery, meter and input terminals are all made directly to the boards. All board-mounted preset potentiometers are accessible by removing the "snap-on" range plate allowing adjustments to be made with the meter fully assembled.

Another worthwhile feature is the rubber covered test leads. These are superior to the normal PVC covered leads which are readily affected by heat.

DROPPABLE METER

During the laboratory measurements we took Weston at their word and dropped the unit several times from a height of five feet onto a carpeted floor and then once onto a concrete floor. After these drops there was no measurably change in sensitivity, but the case had a slightly deformed corner where it hit the concrete. The meter remained well within the manufacturer's tolerances on all ranges and scale calibration was maintained.

The only slight disadvantage we found with the meter was the constant 100 millivolt loss on the current measuring ranges. This could cause measuring errors on the 1 μ A range in some circuits.

The meter supplied was complete with a 27 page instruction book covering:—

i) general description
ii) specifications
iii) operating instructions
iv) theory of operation
v) maintenance.

The section on "Theory of Operation" has schematic illustrations of each basic mode of meter operation, together with a basic circuit description. The maintenance section contains printed circuit board layouts, component values and part numbers, and gives comprehensive wiring diagrams.

The Weston Model 666 Electronic V.O.M. is an accurate instrument that may be used for either laboratory or field measurements. It offers wide measurement capability and is surprisingly free of vices.

It is a very predictable instrument, offering an almost purely resistive load up to quite high frequencies on ac ranges.

The ability to withstand the shock of being dropped from a height of five feet onto concrete without mechanical damage or change in calibration makes this fairly expensive instrument well worth considering in view of its durability and reliability.

Being a transistorised voltmeter it will, no doubt, find increasing use in service organisations in preference to the traditional VTVM.

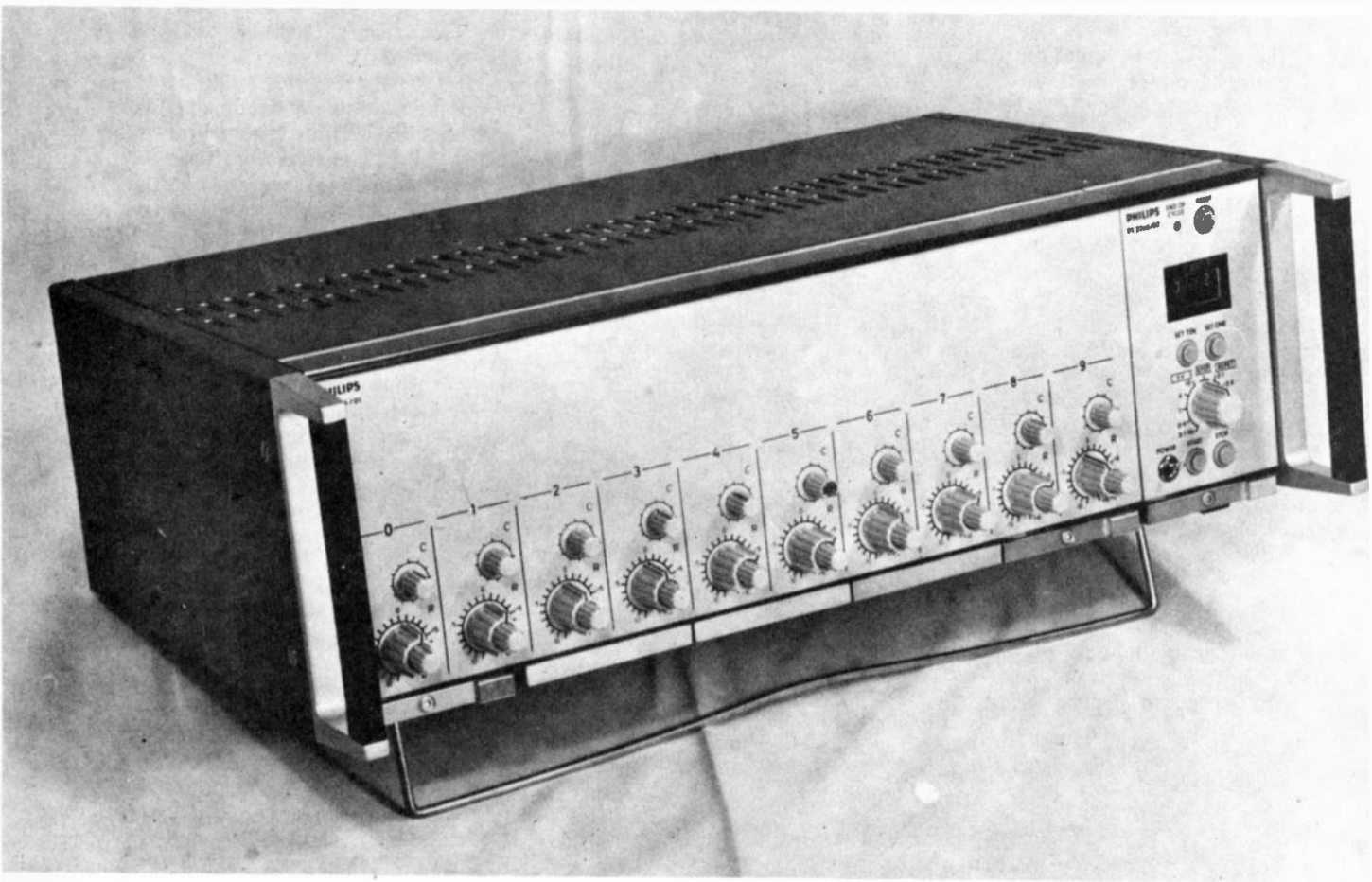
The provision of voltage and current ranges down to 100mV and 1μA respectively, is an improvement over existing multimeters. This is particularly true of ac measurements which previously could only be performed at these levels by using specialised laboratory equipment.

A price of $152.00 will make it an attractive proposition for the user who needs a rugged, flexible accurate instrument. ●

Table 1

SCALE	READING	
BATTERY CHECK		
1μ A	full scale	
10μ A	full scale	
100μ A	full scale	ac or dc
1 mA	full scale	
10 mA	full scale	
30 mA	full scale	
X 1 ohms	10 ohms centre scale	
X 10 ohms	100 ohms centre scale	
X 100 ohms	1000 ohms centre scale	high or low
X 1000 ohms	10 k ohms centre scale	voltage source
X 10 k ohms	100 k ohms centre scale	
X 100 k ohms	1 M ohms centre scale	
X 1 M ohms	10 M ohms centre scale	
.1 volt	or	-20dB
.3 volt	or	-10dB
1 volt	or	0dB
3 volts	or	10dB
10 volts	or	20dB
30 volts	or	30dB
100 volts	or	40dB
300 volts	or	50dB
1000 volts	or	60dB

NEW SCANNING



A COMPACT multi-channel bridge-balancing and scanning system in which preheating of strain gauges prior to measurement ensures drift-free operation and permits high-speed scanning, has just been introduced by Philips. The system can be used accurately to balance and continuously scan up to 100 individual strain-gauge or transducer-bridge networks.

The system is intended for use with strain gauges, transducers employing such elements, and inductive transducers, and can be employed in test and monitoring systems measuring such parameters as stress/strain, pressure, acceleration, differential pressure, torque, displacement and temperature. It is intended to be used in conjuction with measuring bridges such as Philips PR 9307 or PR 9308 and a recorder or oscilloscope, and provides a very effective means of monitoring physical parameters that vary at medium and low frequencies.

BALANCING TO WITHIN 0.05 u STRAIN

The PT 2266 system comprises two basic units: one 10 or 20-channel bridge-balancing and switching unit and a control unit. The bridge-balancing unit permits each bridge network to be accurately balanced to within 0.05 u strain through combined use of a 23-position resistor network and a 10-turn potentiometer, and allows strain-gauge imbalances of up to ± 2.5% to be corrected. During actual measurements, all the strain gauges except the one being measured are pre-heated to eliminate drift problems. When the scan switches to a new channel then the pre-heating is switched from this channel.

The above system can be used with strain gauges connected in quarter, half and full-bridge circuits employing 2, 3, 4, 5 and 6-wire conductor systems. With all these circuits a special relay-contact configuration can be used to eliminate any instability in contact resistance. The system can also be used with strain-gauge type transducers, inductive transducers and thermo-couples. With all the above connections plug-in circuit boards within the unit provide the additional bridge components necessary for each measurement-point network.

Scanning of the 10 or 20 channels is carried out via the control unit. This permits the following scanning modes:

1. Manually-controlled scan
2. Automatically-controlled scan

SYSTEM

Multi-channel scanner uses pre-heated strain gauges to ensure drift-free measurements

3. Automatically-controlled scan for one cycle
4. Scan controlled by external pulses

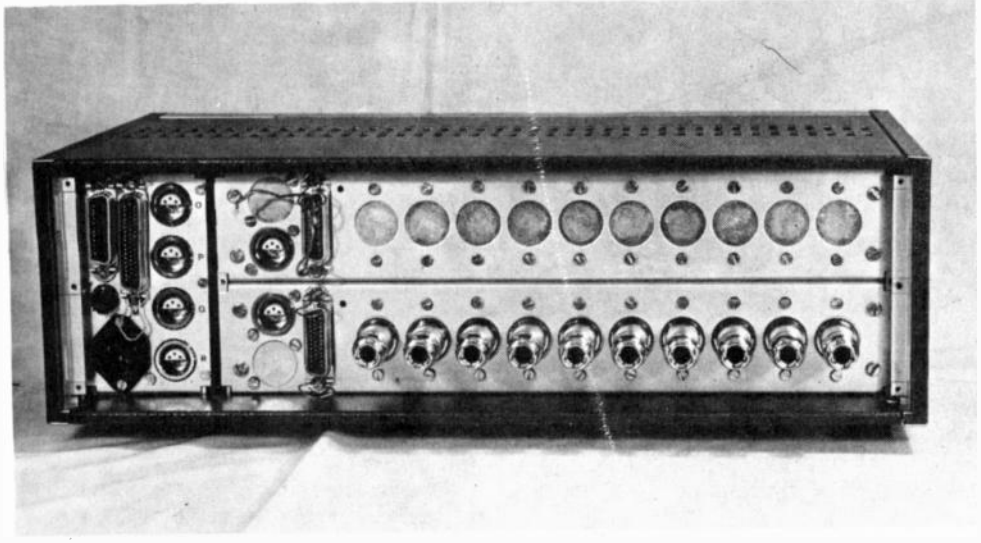
In the continuous-scanning mode one of four speeds between 0.5 and 10 channels/s can be selected. The slowest of these speeds is used mainly for balancing purposes and for measurements with low-speed recorders. If the scan is controlled by an external pulse generator, then it is possible to have a variable scan speed.

When more than 20 channels are needed in the test or monitoring system, additional 10 or 20-channel units can be added, up to a total of 100. In such cases it is necessary to use a group divider unit that switches the control unit's connections from one 10 or 20-channel balance unit to the next as the scan proceeds. A digital display on the control unit indicates the particular channel being scanned at any given time.

ZERO AND SENSITIVITY CHECK AS OPTIONS

As well as its standard features, two options will shortly be provided. The first of these permits the measuring bridge or channel's sensitivity to be measured against a calibrated signal whose amplitude can be adjusted. The second allows the K-factor of each channel to be adjusted with the range 2.2 to 1.8 thereby permitting its sensitivity to be adjusted. Other K-factor ranges can be provided for measurements with inductive pick-ups.

The complete PT 2266 system makes extensive use of high reliability relays and printed-circuit techniques, and alos employs high-quality Lemo plugs to minimize contact-resistance variations which are critical in circuits where signal levels are in the microvolt region. The system's compact dimensions make it suitable for mounting either in 19-in rack or test-bench housings. Normally, one control unit and a 20-channel balance unit can be accommodated in one 19-in rack drawer and additional units can be added in adjacent drawers. A complete 100-channel system can also be accommodated in a standard 15 x 5¼ in bench housing. ●



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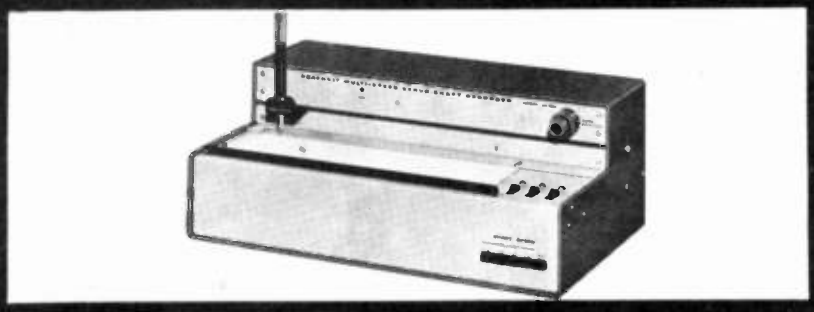

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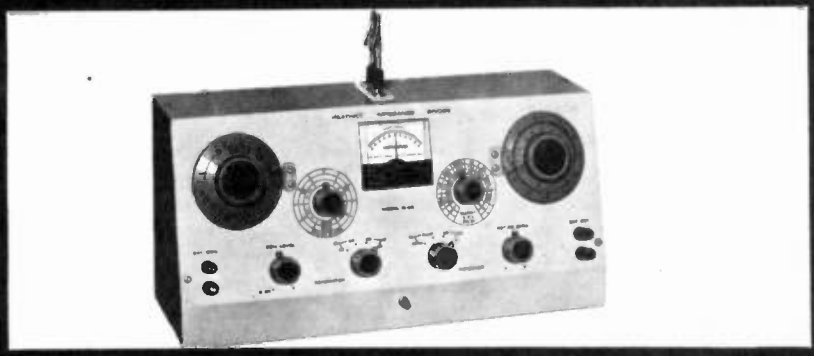

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Gravity waves or not?

Gravitational radiation, the so called "gravity-waves", have now made their appearance in the press. But whether they have really been detected has not yet been proved. The whole question of detecting them is the subject of international collaboration and a number of detectors are being built in laboratories in countries the world over.

DETECTING such waves needs extraordinarily sensitive instruments. Basically, they must work by detecting the relative acceleration of two masses separated by some distance, and sensitivity will vary according to the direction of the arrival of the gravity wave. The relative force is turned into an electrical signal by piezoelectric material, a material that will produce a charge if its shape is changed, for example by pressure.

Experiments in the USA with one detector at Maryland University and another at the Argonne Laboratory a thousand kilometres away have been done, using an aluminium cylinder, suspended in a vacuum. The cylinder's lowest normal frequency of oscillation along its length is 1660 Hz. Piezoelectric material glued to the surface of the cylinder converts mechanical oscillations into electrical ones which can be amplified and recorded.

A gravity wave can produce tiny oscillations in the cylinder, which, of course, may be masked by random "noise", so the results from one detector are compared with those from another to see if there is a match of signals, evidence of a gravity wave. A signal, nevertheless, could still be caused by seismic, electromagnetic or cosmic ray disturbance and other arrangements have tobe made to sort these out, too, so that what is left is a gravity wave signal.

Results so far appear to show that gravitational waves have arrived at a rate of about one a day and that they cluster as if the sources of the waves are at the centre of the Galaxy.

The origin and causes of gravitational radiation mean navigating the difficult stretches of Einsteinian physics. But, assuming that waves are radiated, they would certainly be extremely weak compared with electromagnetic waves. Most of the power of gravitational waves in the solar system, expected to be produced by planets moving round the Sun, is produced by Jupiter and amounts to about 450 Watts and a similar amount comes from the Sun.

Yet the power of electromagnetic waves from the Sun is about 10^{24} times larger. More powerful gravitational waves could come from a collapsing stellar mass but even so a gravitational pulse received at the Earth from it would last only a minute time. A collapsing star ten times as massive as the Sun would produce a pulse lasting probably less than a thousandth of a second.

Professor P. B. Fellgett of Reading University and Dr D. W. Sciama of the Department of Astrophysics at Oxford, in a survey of gravitational wave astronomy, say that if the US observations are correct, they provide some difficulties to astronomers.

The rate of events is high, so it may be that processes occuring in the centre of the Galaxy are different from those that can be studied in detail in the nearer parts to us. Secondly, the Galaxy must be losing energy and mass by gravitational radiation at a rate of several hundred solar masses a year. Through these difficulties are not insurmountable, the claims must be tested by independent experiments with other detectors.

They say also that, as well as the piezoelectric method, others, including capacitive and optical methods, ought to be explored in detecting the relative acceleration of the two masses. The preferred form of detector at present is a cylindrical bar, split into two halves with the piezoelectric material sandwiched between the two halves.

The wave form of a gravitational signal from the most likely source of radiation – the gravitational collapse of a stellar body or the capture of one collapsed object by another – can be predicted, as also can its duration.

Assuming that the waves travel on average over the distance from the Earth to the centre of the Galaxy, the energy needed to produce a detectable signal and the signal's frequency can be calculated.

This frequency is near to that at which detectors have been resonated. But it is hard to believe that an object of the necessary mass, collapses or captures another almost every day, which is what results so far seem to imply. Perhaps, Fellgett and Sciama say, it would be better to make a detector more sensitive to the occasional slow event that could be produced by a super-massive object or to concentrate on fast events taking place close to Earth on a galactic scale.

They conclude that, theoretically, it would be surprising if gravitational radiation did not exist, though it is not proved. Probably, uncertainties will be resolved one way or another in the next twelve months. ●

STOP PRESS

DOLBY IC

Signetics' DOLBY integrated circuit will be available in prototype quantities early in May.

In effect the chip performs all the functions of the Dolby B system. External components are limited to a 19 kHz filter and a number of precision capacitors.

Signetics local agent is Technico Electronics.

THE SMALLER ADVENT LOUDSPEAKER

Just as we go to press we hear that a smaller version of the Advent loudspeaker – called appropriately enough – the Smaller Advent Loudspeaker – is to be made locally by Auriema Pty Ltd. It is believed that the units will be priced at approximately $128 each including tax.

An exclusive review of this new unit will be published as soon as possible.

AUSTRALIAN ADVENT LOUDSPEAKER

Is the Australian-built Advent speaker as good as its American counterpart? Here are the facts.

electronics TODAY product test

Import duty on most loudspeakers imported from the USA is 45%. Sales tax – at 27½% – is charged on the duty paid price. Add on distribution costs and profit margins, and the reason why we pay so much for our XYZ speakers becomes only too clearly apparent.

Hence Auriema's logical decision to produce Advent Loudspeaker systems in Australia by manufacturing the cabinets locally and importing the drive units and crossover networks from the USA.

Unfortunately the first locally built units fell somewhat short of being an unqualified success.

Resonances in the enclosures produced significant colouration and audible distortion resulting in a performance that could not be equated with the results obtained in our test of the US built Advent unit (November 1971).

Although a few of these early speakers were sold, it is to their very great credit that Auriema accepted full responsibility for the manufacturing problem, withdrew all remaining stocks and actively sought to overcome their difficulties.

And overcome them they have – for the revised units are not only as good as the US built speakers in every respect – but in one or two areas they are actually better.

So confident were Auriema that they had overcome their difficulty that they asked us to consider running a full product review comparing the US

(a) The cone suspension system, and its linearity of performance.
(b) The manner in which the enclosure is constructed.
(c) Internal lining used to provide absorption and damping.

The US built Advent enclosure utilizes a hardwood based particle board, which being denser and more rigid, provides better damping than the softwood particle board generally used in Australian made speaker enclosures.

However, the use of *softwood* particle board for the initial batch of Australian made speakers resulted in an enclosure with substantially different characteristics from the American built units.

The problem was enclosure resonances. At low frequencies the vibrations set up in an enclosure result in each panel acting as a diaphragm and capable of radiating acoustic energy. Ideally these panel resonances must be eliminated to prevent unwanted colouration. The first locally built enclosures had a significant level of these unwanted resonances thereby producing significant colouration and audible distortion

ENCLOSURE DETAILS

The three enclosures tested were constructed as follows: the American enclosures – ¾" veneered hardwood

built unit that we tested originally, with a revised unit (chosen at random from their stock). They also provided one of the original (faulty) Australian built units.

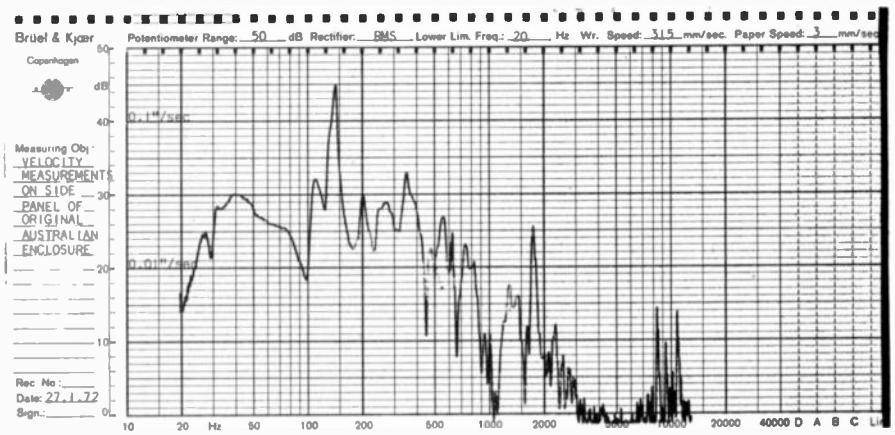
SEALED ENCLOSURES

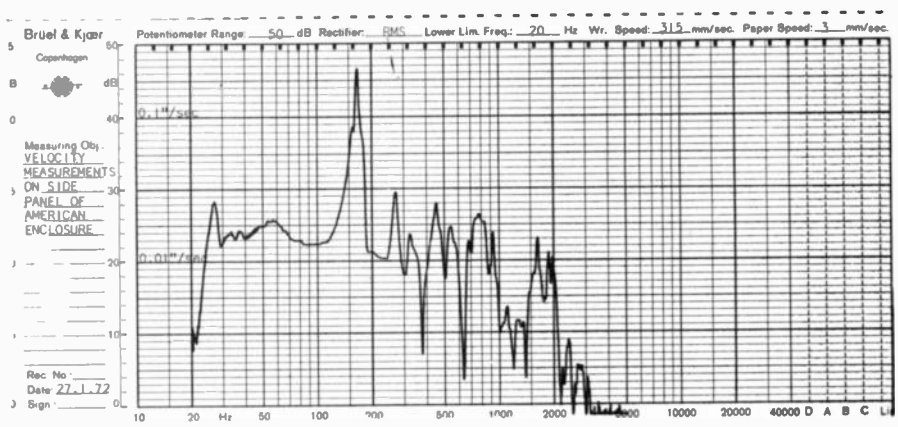
The performance of a loudspeaker system depends as much on the enclosure design and construction as on the speaker units themselves. The two are interdependent.

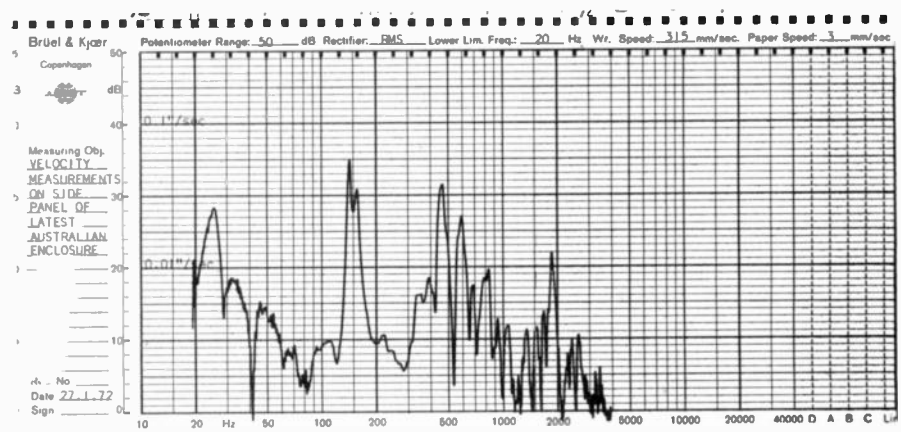
The most popular enclosures fall into two categories, being either fully sealed, or vented. The vented enclosure acts as a resonating system tuned to suit the resonant frequency of the speaker, so that correct acoustic loading is applied to the cone. This is necessary for a good clean bass response.

Sealed enclosures, such as the Advent speaker system, are also becoming increasingly popular, particularly in bookshelf systems because of the smaller volume required, (they are also known as infinite baffle enclosures). However, their use is limited to speakers specially constructed for this purpose. The volume of a sealed enclosure is important and must be modelled to the requirements of the speaker to be used. The volume of air in the enclosure is directly related to the stiffness required correctly to load the speaker.

The overall performance of the speaker system is dependent on the following factors:–







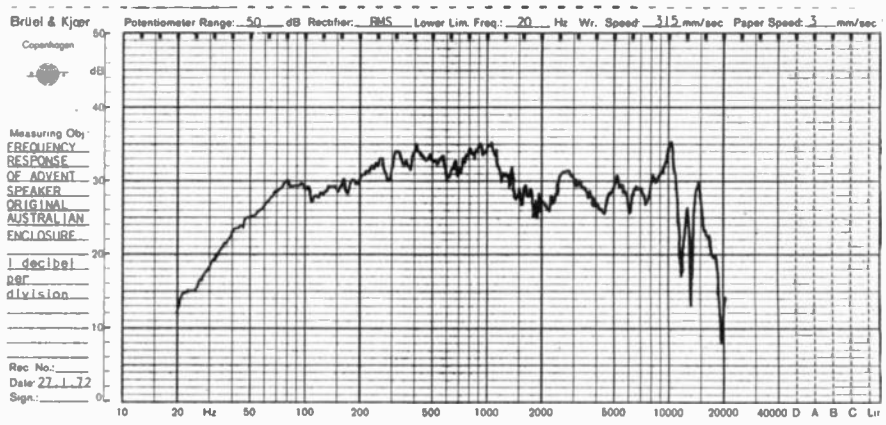
Figs. 1,2,3. These spectrograms show the velocity of vibration on the side panels of all three speakers. The critical area in these spectrograms is the average level between 20Hz and 150Hz. Note that this level in the latest Australian-built unit is substantially lower than the earlier unit. (The unwanted acoustic output from the panels of the enclosures is related to the square of the velocity).

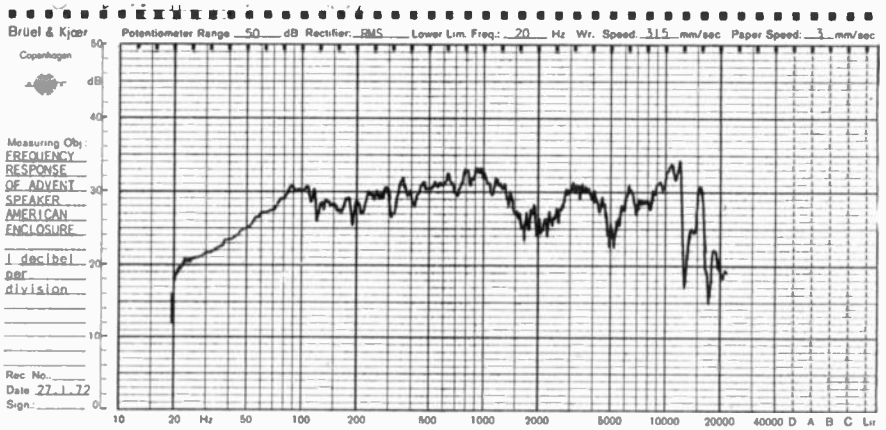
AUSTRALIAN ADVENT LOUDSPEAKER

based particle board. The original Australian enclosures – ¾" veneered softwood particle board. The revised Australian enclosures – ¾" veneered softwood particle board lined with 1/8" hard board and additionally braced with two ¾" x ¾" timber members centrally located.

The external appearance of the Australian made enclosures is different from the American systems in a number of ways. Firstly, the Australian grille cloth has a closer weave of a lighter (buff) colour; secondly, the grey plastic baffle trim used in the American unit has been replaced with a dark brown trim that blends well with the timber veneered enclosure, lastly the chamfered timber surround on the front of the enclosure has been changed from a veneered timber moulding to a solid timber moulding with a distinct joint between it and the box. In our opinion the finish of the Australian enclosure is at least equal to, if not better, than the American unit.

The drive units are exactly the same as those used in the US built enclosures. These units are particularly





MEASURED PERFORMANCE OF ADVENT SPEAKERS

FREQUENCY RESPONSE

Original Australian Enclosure	
S/N 00002	40 to 15kHz ±6dB
Latest Australian Enclosure	
S/N 00012	30 to 16kHz ±6dB
American Enclosure	
S/N 21367	30 to 16kHz ±6dB

SPEAKER RESONANCE IN ENCLOSURE

Original Australian, 45Hz
Latest Australian, 45Hz
American, 45Hz

POWER INPUT FOR 3% TOTAL HARMONIC DISTORTION

	100 Hz	500 Hz	1000 Hz
Latest Australian	15 W	20 W	18 W
Original Australian	2 W	18 W	14 W
American	16 W	23 W	18 W

WEIGHT:

Original Australian	31 lbs
Latest Australian	39 lbs
American	37 lbs

PRICE: Maximum recommended retail price – $169.

* This speaker has been fitted with a new tweeter since performing the original review).

well designed and constructed.

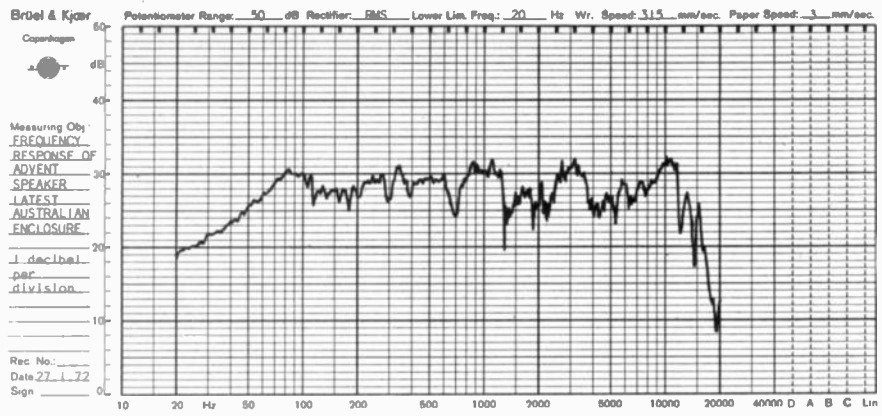
The tweeter is constructed with a phenolic dome fitted to an aluminium voice coiler former. The magnet assembly is one of the largest we have seen, measuring 3" square by ½" deep. By contrast the magnet on the woofer is only 3½" square by ¾" deep.

The Australian made systems, which utilize all American components, have the same terminal panel as the American unit. This is centrally located in a cut-out in the back panel. This panel has two screw terminals marked 0 and 8 ohms for cable termination and a three position toggle switch with extended, decreased, and normal positions, providing approximately 3dB boost or cut around the normal performance. The crossover network is very simple, utilizing one ferrite cored choke and a couple of capacitors and resistors.

As with most of the better quality sealed enclosures that we have seen, a dense tenacious putty is used in the Advent speakers to seal the woofer and tweeter openings and the aperture around the terminal panel at the rear of the enclosure.

SUBJECTIVE TESTING

The subjective tests consisted of A-B comparisons between the American and both Australian versions. The response of the original Australian



made unit was very poor with excessive colouration of the bass response, and a loss of presence and brilliance. This showed up in the measured frequency response curve, and in the measurements of vibration in the panels of the enclosure.

Differences between the American and latest Australian built version were very hard to detect. The only significant differences were a slightly improved bass response and a slightly smoother high frequency response. These differences were readily detectable using the JBL test record PRO 496 and the CBS record called "Holiday for Orchestra". This record features Eugene Ormandy conducting the Philadelphia Orchestra and on side one the first two tracks feature most orchestral instruments.

Tests with the CBS record were conducted with one speaker on our left and one on our right and with both speakers driven by a mono signal derived from the record's stereo output. A (subtle) difference that could be detected between the two speakers was a slightly cleaner reproduction of bassoon, bass drum and basses from the Australian unit, and a slight difference in timbre of the piccolos and violins between the two speakers.

Laboratory measurements confirmed our subjective tests. These measurements consisted of axial frequency response and distortion measurements, as well as a series of vibration measurements at selected points on each enclosure. The vibration measurements consisted of acceleration and velocity measurements on the top panels, side panels, and rear panels of each speaker, using a miniature accelerometer and wax clamp. Typical spectrograms of velocity measurements on the side panels of the speakers are shown in Figures, 1, 2 & 3.

The critical region in these spectrograms is the average level of velocity between 20Hz & 150Hz, and a change of 6 decibels in level is equal to a doubling in velocity (the acoustic output from each panel is related to the square of the velocity.)

From these spectrograms it can be seen that the *average* velocity level in the low frequency region of the original Australian unit is typically 5 to 6 decibels higher than that of the American made Advent and 12 decibels higher than the latest Australian enclosures. These results confirmed our subjective appraisal and explained the cause of the colouration in the response of the original Australian unit and the slight loss of clarity in bass response of the American unit.

The measurements of distortion were most telling, for whilst the American made Advent and the modified Australian units were particularly good, the original Australian-made enclosures produced 3% distortion at 2 to 3 watts input at a number of spot frequencies. (These spot frequencies were determined by the panel resonances rather than speaker cone break up).

The local modifications have resulted in a low level of enclosure resonance and we can state categorically that the latest Australian made Advent speaker systems are every bit as good as the American made units. ●

The Auriema company have told us that a small number of faulty Advent speakers were sold to the public.

Although most of these units have now been located and remedied it is believed that there may still be a few faulty units in service.

Auriema Pty Ltd would welcome the opportunity to correct the deficiencies in these speakers (serial numbers less than 100). Any such owners are asked to contact Richard Whyte at Auriema Pty Ltd. Telephone 939-1833. The company will carry out the modification totally free of charge and will also pay all transport costs involved. Which seems fair enough.

CAPTOR-
a new approach to data capture

By P. CHASTNEY

Fig. 1a

P. Chastney is the Chief Engineer of Plessey's Environmental Sensors Division.

This article describes a low cost information retrieval system that uses a unique film storage technique.

THE TASKS undertaken by computers are continually expanding and this implies expansion of transmission networks and various interface mediums to keep pace with the demand. The methods of recording data are also undergoing radical change and there exists a need to record data and events when they happen. These recordings, coming under the general heading of data capture, must in essence comprise a human-to-computer interface and involve the absolute minimum of operator interpretation and intervention.

Data in this context is a term that contains all intelligence about an event which has taken place; an event is the basic subject matter which can be modified by variable features and qualified by an amount such as the quantity of a product or a price for a transaction. Data can be recorded by pushing buttons, inserting keys or cards, with magnetically marked articles or a host of other input systems. The method used for storage and display presents an equally wide choice; the criteria that determines the methods to be used in a system are convenience, accuracy, requirements and cost.

The system described, designed to meet a specific cost market, stores all fixed data on film which can be displayed when requested. The film is photographed directly from a computer print-out by a step-and-repeat camera (or may be created as a 16mm film directly from magnetic tape). The system shows cost advantages during the up-dating and processing operations when compared with other storage and access systems.

Figure 1a shows a model which, although designed by Plessey to meet a general requirement, lent itself readily to an adaption for a pharmaceutical market survey. Here data, in the form of product invoices, are collected from retail outlets and sent to a central establishment where coding, sorting and punch tape preparation takes place before statistical analysis by computer.

The system diagram, figure 1b, is the module sub-division showing that each line of information is arranged into

formats by a programme unit. After selection, a format line allows data to be entered in random order. Further keyboard data insertions are inhibited when the programmed data for any line is completed.

In addition to access for the film display and verification of individual lines selected on the display, quantity is confirmed by digitrons and provision is made for items not listed, by selecting alpha, which gives free use of the keyboard.

ELECTRONIC KEYBOARD

The keyboard used on this machine has been designed with mass production techniques in mind. Each key contains a Hall effect generator and amplifier as an integrated chip. Moving parts are enclosed in plastic guides and each key is individually replaceable. Consequently, the keyboard can be arranged according to user requirements. Each key is bounce-free and generates the eight-element ASCII code with a parity bit. The output code levels are fully compatible with 5V DTL or TTL integrated circuit logic functions.

For the purpose of this system the digits 0-9 are used to indicate months in addition to quantity, with the characters + and - for November and December. In addition to the standard alphabet in upper and lower case, punctuation characters are used in the system to denote "country of origin", which can be either inserted from the keyboard or selected from the pre-set switch provided under a lift-up desk top. Function keys, which are provided on the right-hand side of the keyboard, are used to select format lines such as retailer, wholesaler, manufacturer, alpha, while a separate group of buttons allow control functions such as message end, cancel and correction. When pressure on any key is released, a further character may be inserted.

The integrated circuits are dual-in-line plastic packages mounted on flow-soldered printed circuit boards. These boards are arranged in layers, interconnected along one edge by Mylar encapsulated strip wires. This allows full servicing of the keyboard, during operation if necessary. In addition to keyboard function reliability, there is a requirement for minimum wear. This keyboard has, from the present evaluation, fully justified its use.

COUNTING SYSTEM LOGIC

Each frame from an endless loop of 16mm film, contains a block which is recognized by phototransistor sensors while passing the gate area. This is shown in Fig. 2. Each block is identical and is produced by a cut-out in the camera frame format. At the spliced ends of the film loop is a larger block, arranged to cover two sensors. This causes a reset pulse to be generated. The film travel is unidirectional and for every complete rotation, counters are reset; the film in its gate is shown in Fig. 3.

Since the keys generate the ASCII code, use is made of the first five elements which contain the binary coded weighting. It is evident that a choice of two letters from the alphabet can produce a selection from A to Z square, i.e. $26^2 = 676$.

The first input character from the keyboard goes to shift register A (see Fig. 4). When the second character is inserted, the contents of A are shifted to register B.

For general applications, 506 frames are required, these being arithmetically grouped as follows:

The first character keyed (letters A–W) represents one of

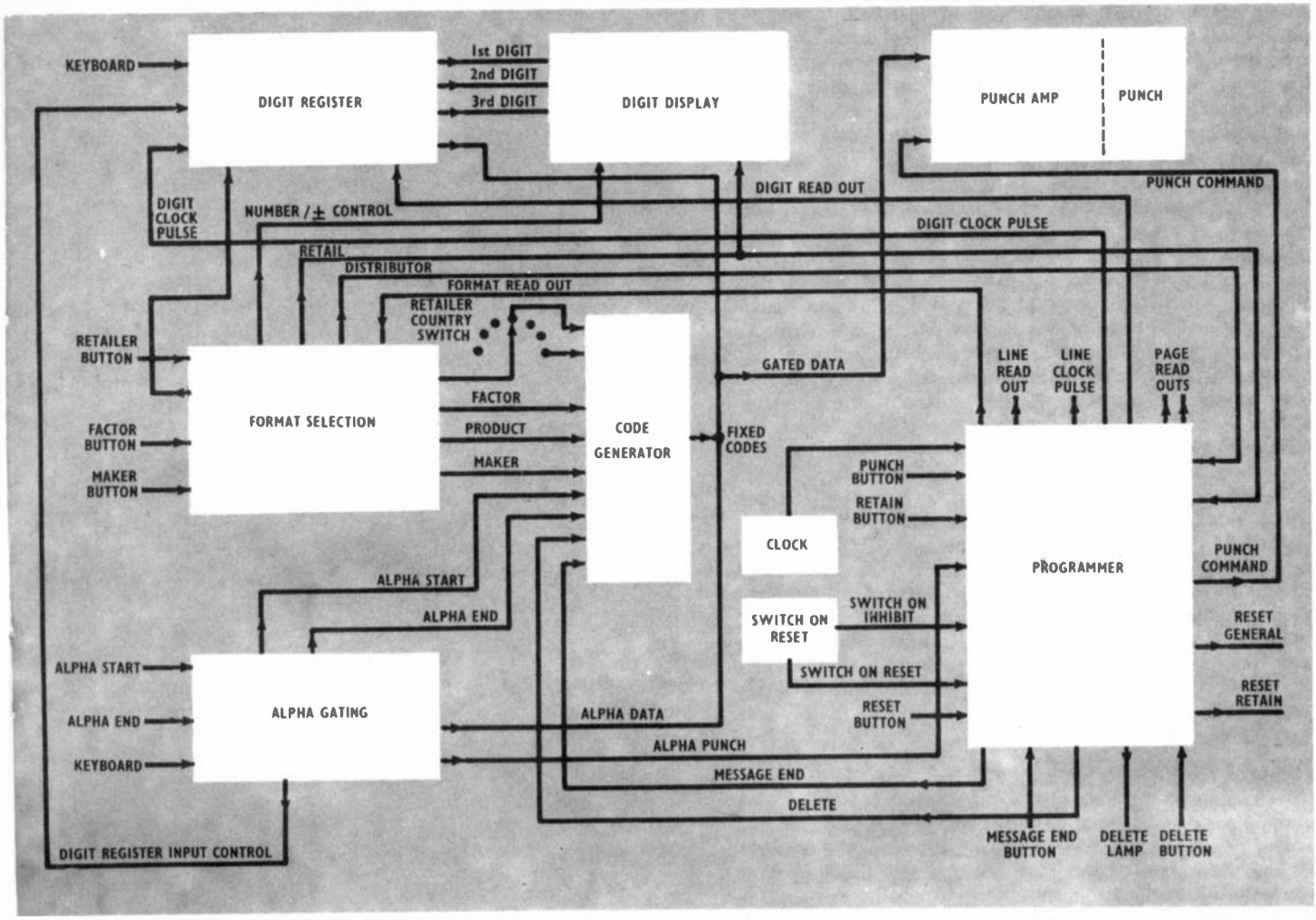


Figure 1b. Block diagram of the Captor system.

CAPTOR-

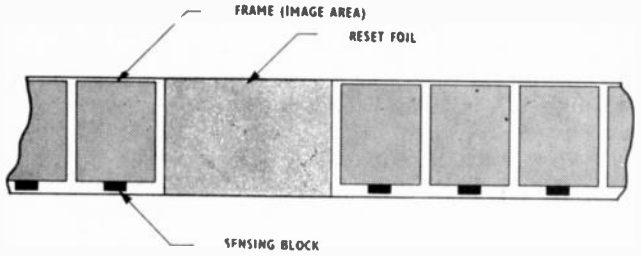


Fig. 2. Section of film

23 groups of 22 frames. The second character keyed (letters A—V) represents one of 22 single frames.

For example, if characters NL are keyed:

N represents the 14th group of 22 frames

L is the 12th frame within that group

NL, therefore, asks for the (14 x 22 + 12) frame = 320th frame.

Identical grouping systems are used for the counters A and B. Output from the comparators operates the film motor control until equality is reached. Another call-up system uses the first three sequential letters of a name or product description to identify precisely the film frame. Six coding bit positions are available on each frame; these relate to an alpha letter and an index level or an operational code. The searching and stopping electronics are controlled by comparators instead of counters.

To obtain rapid selection and ensure accuracy of correct frame selection, a fast and slow mechanism is used. Any group of twenty-two means fast, while single frames are slow. It is, however, necessary to cater for even or nearly even groups: this is readily achieved by adding one pulse to the group counter whenever groups are present in the comparator. If, therefore, the difference between counters and registers, as selected, is less than twenty-two, the film will move slowly; if the number is greater than twenty-two, the comparators will find equality at the fast speed and run slowly for twenty-two frames. A pulse width system is used for the drive motor which is varied according to the speed requirement.

Each displayed frame contains seventy lines of data arranged into two columns of thirty-five items and against each line on the side of the display screen is a lamp. To select one line of data from the seventy displayed, two further button actions are required from the keyboard. In later models, buttons are located adjacent to each lamp; operation of an identity button automatically inserts the code, thereby reducing both time and error probability.

The total number of data lines in the film store is 35/420 derived from 506 frames (23 x 22) each containing 70 lines. Without expansion of a further character from the keyboard, the system will accommodate 47,320 lines of data (26^2 x 70), access to any item being available within a maximum time of two seconds. When the correct frame has been selected and displayed, counters and registers are equal. The registers are, therefore, cleared, allowing line identification characters to be inserted. These cause illumination of an identity bulb and line verification before punching.

DISPLAY MODULE DESIGN

The design of the data display unit incorporates features which were deemed necessary but which were not available in any commercial product. The most important features are low wear rate of the film, rapid access together with correctly definable stopping point, a coding system for location which does not necessitate different markings on each frame, simple interchange of components subjected to wear and simple mechanical construction.

The frame from the film is rear-projected on to a diffused screen some 12in x 10in in a vertical format. This represents a x 24 magnification of the 16mm frame, the illumination source being a 100W tungsten-halogen lamp. The optical path to achieve this magnification is shown in Fig. 5. This uses two front-silvered mirrors, one of which is adjustable for vertical screen positioning. Since the film is held rigidly between two tapered guides during its passage through the gate, its vertical position on the displayed screen is accurately defined and repeatable.

To obtain horizontal location within a few thousandths of an inch at the frame gate, the stopping mechanism is arranged to sense one half-frame early. The motor control is controlled by two sensors and amplifiers located at the top of the projection screen. Here the block is magnified and, as illustrated in Fig. 6, the horizontal positioning can be controlled within very small fractions of the magnified frame; the final position is within ±¼in.

The photograph (Fig. 7) of the film canister shows how the film forms itself in loops, thereby ensuring very low mass for stop and start movements. The tapered guides which lead the film into and out of the gate are surface anodised, whilst the container profile is concave so that there is minimum friction. Drive is transmitted to the film through a roller and pinch idler, and components which can be subjected to wear are designed for rapid interchange. Film guides, which are split, allow simple access for film replacement and location is assisted by tapered studs.

The optical system has a double condenser lens and a heat filter. Heat is removed from the film surface by an extractor. The gate glasses are opened when the film is moving but a shutter obscures the optically projected picture; the shutter, however, has an aperture which allows projection of the marker blocks on to the screen. When the correct frame has been reached and the film is stationary, the shutter is withdrawn and the gate glasses close. In Fig. 1a it will be noted that the equipment incorporates two screens. The left-hand display screen is for a microfilm projector, whereby invoice copies etc., which have been photographed, can be sequentially placed before the operator without causing undue piles of paperwork on the console surface.

INTEGRATED CIRCUIT SYSTEM

With very few exceptions, all functions are TTL dual-in-line plastic packages. The exceptions are a few discrete diodes and power drive transistors and some DTL power gates for expansion. Each complete electronic function is allocated to a printed circuit board; these boards are mounted via edge connectors into one compact container. Fig. 8 and 9 show respectively a typical board with its integrated circuits and the total electronic circuitry in the container.

The container is mounted on slides within the console so that servicing is simplified by exposing both the motherboard interconnections and the individual cards.

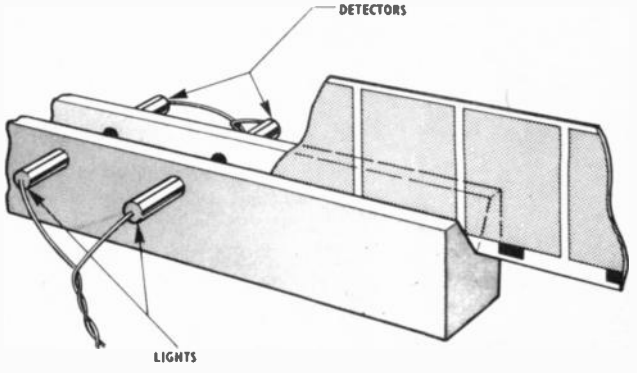


Fig. 3. Section showing film in film guide.

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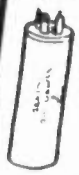

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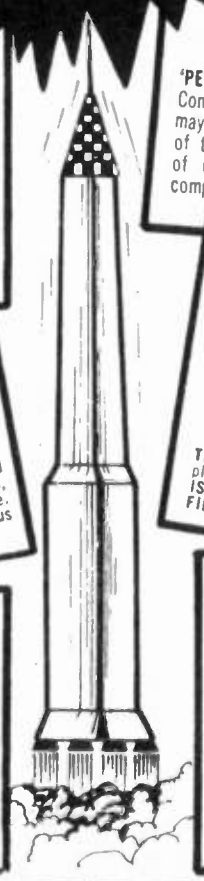

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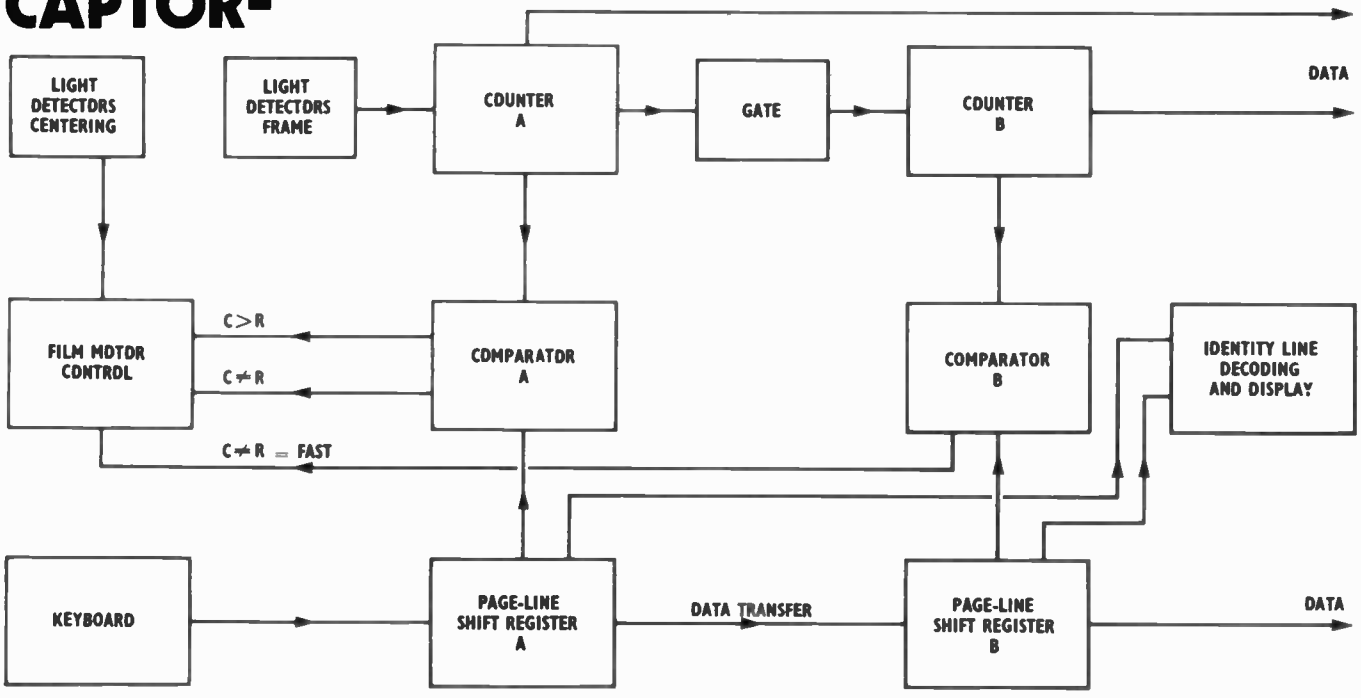


Fig. 4. Counting system diagram.

Wide tolerances in logic levels are allowable and this, together with a design well within maximum ratings, permits a high degree of confidence in full performance reliability.

PUNCH TAPE AND VERIFICATION SYSTEM

During the design stages, particular emphasis was placed on the likely environment for this type of machine. If this is an office, it will be advantageous to reduce noise to a minimum. The film unit, driving low mass is nearly noiseless, so too is the keyboard. The tape punch, a noisy part, is mounted inside the console and provision made for loading etc., through a panel door. Tape run-out or breakage is indicated by panel lamps. The punch tape unit is driven at ten characters per second, which is well within its capability and quite adequate for a temporary storage system.

Alphabet codes which define page selection and line identity are stored until a data line is completed; the line is then released by a "Punch" button which also clear the registers. If, however, a page should be retained because it contains the next data line item, a "Retain" button is selected. This allows punching to take place but does not clear the page register; only the line identity need be inserted for the next item.

If the tape is used to operate a reader and this resultant output is interfaced at the keyboard output, the system may then be driven in reverse, needing only a line completion signal for a fully automatic servo-loop checking system. Each page, line, quantity etc. will be sequentially displayed at a rate controlled by the film mechanism. A complete verification can, therefore, be made at much greater speed, against a check copy if necessary.

USER REQUIREMENTS

Recent market surveys have shown that there is a need for a low cost, reliable data system, which displays thousands of items, any one of which can be selected within one or two seconds and which, without elaborate coding or interpretation methods, will allow such a record to be made clearly identifying to a central or muncipal computer the precise item without ambiguity.

A tape output has been chosen for this model, but it could equally be punched cards, magnetic tape, or a direct telegraph line interface. Modems are expensive and are used when greater transfer speed between computer and user is required. The customers for whom this low cost data system is intended may have access to a remote computer or hire time. They may even be prepared to store a quantity of data before processing. Others may wish to feed the encoded data through a simple translator for the preparation of invoices, delivery notes, etc. Stock up-dating for wholesalers, distributors and manufacturers is clearly viable where high-speed processing is unjustified.

Up-dating costs for re-arrangement of the store content must be at a minimum and, if it is assumed that the magnetic tape-to-film system for reproduction is not readily available, handling during preparation must also be minimized. It is felt that the system chosen meets these cost, time, processing and handling requirements.

The use of punctuation characters to define programmable format lines allows continuous and repeatable use of the whole alphabet for coding, each character denoting a new event, function or feature. Code methods in general use for semiautomated systems, tend to use multiple digits and a complex arrangement for determination of a check digit. Multiple digit systems, in conjunction with a printed look-up for the product, customer name or distribution detail, lead directly to this data capture unit, where an amortized cost return can be calculated in real terms.

MAINTENANCE AIDS (MODULAR CONCEPT)

Each complete function of the system has been designed as a module to simplify maintenance. The cost of mechanically integrating each module with its own electronic circuits, or keeping all of the electronics in one site for routing, was thoroughly investigated. The outcome of this investigation showed beyond doubt that unless each module is to be sold as an individually boxed package, separate electronics are less expensive. A module for all electronic circuit cards, which can be varied according to

CAPTOR-

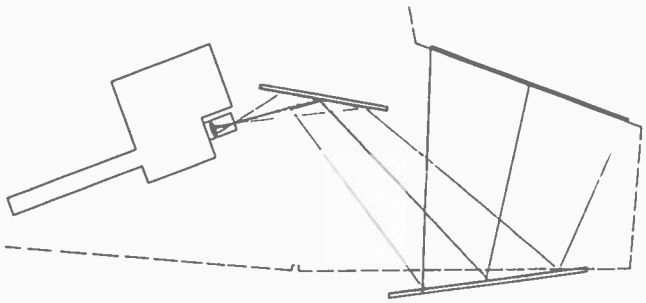


Fig. 5. DAP projection path.

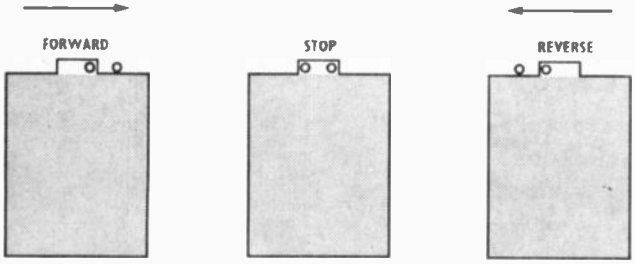


Fig. 6. Three views of the projected image.

the size and requirement of the system, has been incorporated.

Mechanical components, the lifetime of which is predictably short, or which may be liable to catastrophic failure, are designed for simple replacement. Films, subject to wear or frequent up-dating, can be inserted within seconds and need no special alignment instructions.

From time to time, tolerances will build up adversely on items affecting the displayed film image. This will result in a lateral displacement; to correct for this displacement the screen slides vertically out of its guides, giving access to a slide bar containing the photocell sensors, movement of which will re-centre the frame.

Plugs and sockets throughout the system are interchangeable and allow simple removal. Arrangements have also been made to service the keyboard and microfilm projector, both of which are mounted on hinged panels. The projector can be tilted through 90° for lamp, gate and blower adjustments.

PROTOTYPE INSTALLATION

Figure 1a shows the unit installed for system evaluation trials in the offices of Mercados y Analisis S.A. in Madrid, where direct comparisons have been made between trained operators using the existing system and the Plessey "Captor" unit. Some of the lessons learned from this installation are noted in the section on future developments.

Invoices, stock lists and survey results are viewed sequentially on the left-hand screen to obtain a distributor, manufacturer or retailer name, the initial letters of which, via the index, enable a data frame to be displayed. Data frames for each product in turn are then displayed, the complete coding of any item needing four letters from the keyboard in addition to quantity, date or other specific variant.

The existing system uses punched cards on which details are typed in clear; these cards are alphabetically arranged, each operator having only one or two letter groups; this, of course, involves prior sorting. Invoices etc. coming to the operator are also sorted by marking each product item with the operator's identity code. Several Zerox copies of the paperwork are circulated through the office, each operator completing his own work by finding the appropriate punched card, inking in the new item which is added to the existing quantity and adding one to the total of orders received for that product. Additional checks are made by other operators; daily or weekly totals from the cards are inked, using the 80 column system. Cards are then passed to punch and verification operators before despatch by air to a computer in Milan. With the system as described, it is essential for the operator to record a minimum of four items per minute throughout a working shift. Some operators with a high degree of dexterity, can achieve six per minute.

To compete, the Plessey system has to reach at least six lines per minute, at which speed, cost recoveries will allow a minimum amortization period and more important, will enable further survey work to be contracted, which currently cannot be undertaken. The only limitations to rates in excess of ten lines per minute are the programmed material layout on film and the index whereby a specific frame is determined without ambiguity.

The example chosen is typical of commercial requirements whereby any specific identity from some tens of thousands, may be entered and coded within one or two seconds. This, followed or preceded by a quantity and perhaps a qualifying feature, can be programmed as a basic equation, commonly known as a format line. Without further illustration it is evident that the system can accommodate a high percentage of business transactions.

SYSTEM RELIABILITY

Extended tests have been conducted on many aspects, particularly mechanical, of the overall system design, since it is readily recognized that failure of any component part may result in time loss not recoverable without recourse to manual methods or duplicating of systems.

The design of the film drive and guide mechanism was based on the 1000-hour concept between major service intervals. The film, which should be replaced each month for up-dating, causes more wear than it suffers, by the abrasive action of its edges in the guide: this has been overcome by hard anodising. Surface abrasion in the

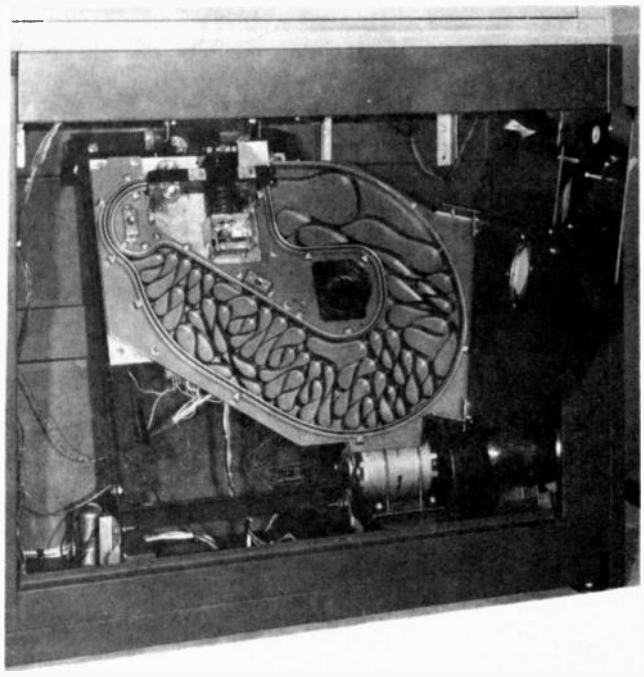
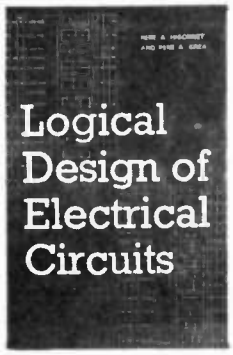
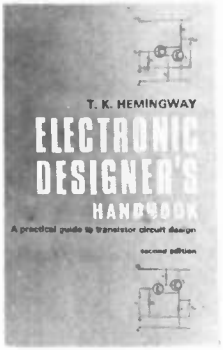
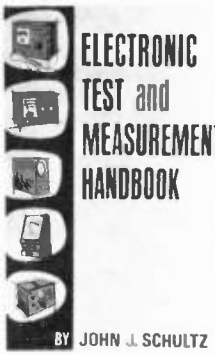


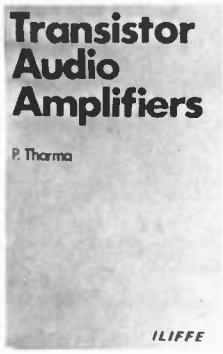
Fig. 7. The film canister.

MAIL ORDER BOOKS









E48. LOGICAL DESIGN OF ELECTRICAL CIRCUITS — R.A. HIGONNET & R.A. GREA — 8 ¾.. x 5½" 220 pp. $8.30.
Virtually all the fields used by the present day circuit designs are covered in the book including combinational circuits (steady state), sequential circuits, which are treated by a modern, simpler method; and shunt-down circuits (inhibitors) described by Boolean algebra. Many worked examples plus more than 300 illustrations are provided.

E16. ELECTRONIC DESIGNER'S HANDBOOK. 2nd EDITION — T.K. HEMINGWAY — 296 pp. 8½.. x 5½" $10.85.
This book provides an up-to-date introduction to transistor circuit design. The basic techniques of design are emphasised and the circuits analysed are done so in such detail that the underlying techniques can be applied to any circuit of a known mode of operation. Contents (in brief) basic circuits; special circuits; useful techniques and troubleshooting.

E50. ELECTRONIC TEST AND MEASUREMENT HANDBOOK — J.J. SCHULTZ — 8½" x 5½" 220 pp. P/B $6.15.
Whether electronic equipment is commercially built or "home constructed" or a combination of the two, eventually there is a need to test it. It may be concerned with verifying or establishing proper operation, checking performance or repairing a defective circuit. This manual is designed to facilitate such testing regardless of its purpose.

E45. TRANSISTOR AUDIO AMPLIFIERS — P. THARNA — 8¼" x 5½" 352 pp. $19.00 pub 1971.
This book presents the various aspects of design of transistor audio amplifiers and is based on the work done by the audio application group of the Mullard Central Application Laboratory. The contents (in brief) cover transistor characteristics, circuit design and measurements, considers various applications and describes circuits.

E10 BREAKTHROUGH — DR. KONSTANTIN RAUDIVE. BOOK & L.P. RECORD. 391 pp. 8½" x 5½" $13.90. Dr. Raudive's research points to the fact that seemingly there is life after death and with the aid of tape recorder, radio and microphone a "breakthrough" has been achieved. This book and the recording of the voices from the dead has been the subject of world wide discussion.

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E14 DIGITAL PRINCIPLES & APPLICATIONS — A. P. MALVIND — D. P. LEACH. 433 pp. 9¼" x 6¼" $10.45. This book introduces the exciting field of digital electronics. It covers all the necessary fundamental concepts offered in a first course in digital systems. Glossaries, review questions and problems with solutions appear at the end of each chapter as study aids.

E15 DESIGNING WITH LINEAR INTEGRATED CIRCUITS. ED. BY JERRY EIMBINDER. 300 pp. 9½" x 6" $11.50. In the past few years integrated circuits have rapidly come into use and have also undergone many changes and found new applications. The authors of these articles, application engineers at integrated circuit manufacturers, provide the latest information on the subject.

E21 THE WORLD OF TOMORROW — K. GOLDSTEIN. 10" x 7½", 128 pp. Well illustrated in colour $3.95. Board a Time Machine and travel a century into the future. Explore the oceans and outer space. Imagine creating and living in tomorrow's world! An excellent gift book for budding young scientists and engineers.

E28 TAPE RECORDING FOR THE HOBBYIST — A. ZUCKERMANN. 9" x 5½", $4.40. This book suggests not only WHAT you can do with a recorder, but HOW. Apart from the hobbyist there are many ideas on what a recorder can do for anybody's home and business life.

E34 BEGINNERS GUIDE TO TRANSISTORS — J. A. REDDIHOUGH. 7¼" x 5", 160 pp. $3.55. Describes what transistors are, how they work, the many types available and their many applications. This will be useful to the layman wishing to understand the fundamentals or the apprentice technician.

E35 DICTIONARY OF ELECTRONICS — H. CARTER. 7¼" x 5", 416 pp. $5.95. The concise but explanatory definitions from many branches of electronics, including radio, television, communications, radar, electronic instrumentation and industrial electronics should prove useful to all those interested in modern electronic terminology.

E36 DICTIONARY OF TELECOMMUNICATIONS — R.A. BONES. 7½" x 5", 208 pp. $7.50. The wide range of definitions, including many reproduced from, or based on, British Standards recommendations, is supplemented by appendices including units and abbreviations, wavelengths and frequency bands and signal reporting codes.

E38 ELECTRONIC'S DATA HANDBOOK — M. CLIFFORD. 8¾" x 5½", 158 pp. $3.55. This is an incredible reference work for both students and technicians as it provides in one volume the formulae and tables most frequently required.

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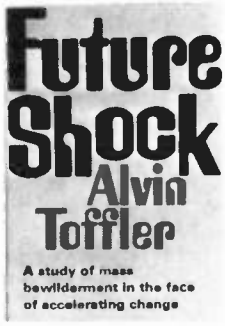
E47 PRINCIPLES OF ELECTRONICS IN MEDICAL RESEARCH — D. W. HILL. 8¾" x 5½". 302 pp. $12.00. Orders taken, delivery 12 weeks. Written specifically for doctors and others responsible for electronics staff and apparatus it describes the more commonly used terms, components and circuit techniques with references to further reading.



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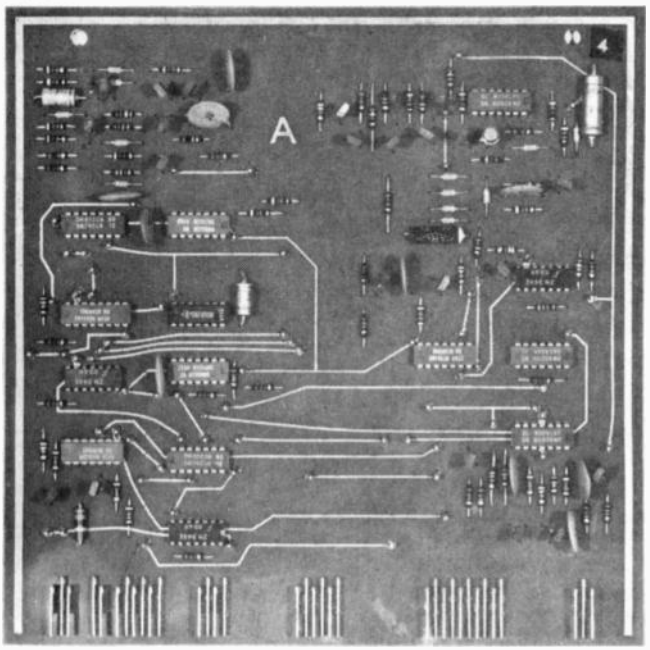

Fig. 8. The digit register board.

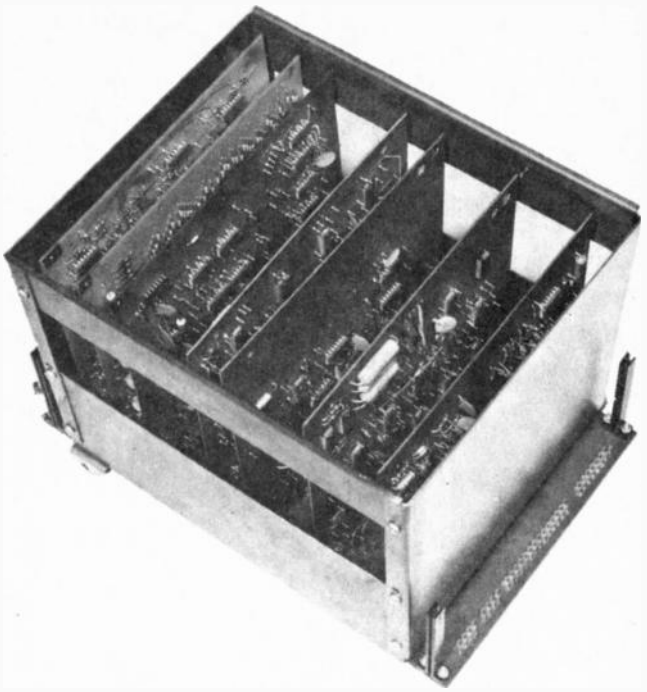

Fig. 9. The boards' container.

container was minimized by concave surfaces, whilst idlers are torque loaded to maintain constant friction with roller wear. These features, in addition to the shaped container, give long life expectancies.

The motor, a Plessey "Series 600" run under pulse conditions, has yet to be fully evaluated, although the life expectancy has been exceeded on mock-up models without failure.

The quartz-halogen lamps used in this data capture system were specially designed for a previous teaching machine project. They differ from the commercial quartz-halogen lamps by having a more robust envelope of a special quartz which also prevents the "poisoning" of the halogen gas.

Integrated circuit functions have been tested to their extremes of logic levels, temperature and fan-out without failure, and since these will not be subjected to rated specifications, checks will only be necessary at the service intervals. The punch unit and keyboard, which are guaranteed for several million operations, have been rigorously tested under extremes of environment and as these represent the input and output of data, the overall confidence level is high.

FUTURE DEVELOPMENTS

The quartz-halogen lamp with an ellipsoidal reflector of dichroic material was encountered late in the development programme and has not, therefore, been subjected to field or serious laboratory trials. The basic principle is that energy in the visible spectrum should be transmitted forwards to the lens focal point whilst infra-red energy is both directed and reflected to the rear through the reflector. This not only reduces the heat at the film plane but allows a condenserless system with thermal escape by ducted convection. The spectrum diagram emphasizes the energy content radiated as heat compared with visible light. The total energy radiated W_{total} is proportional to the fourth power of the absolute temperature T. For a black body radiator, W_{total} = Stefans constant xT^4. Advantages obtained by the use of a quartz envelope are based on a higher envelope temperature which, according to Wein's displacement law λ_{peak} x 2900T and since the peak λ is lower, more energy will fall within the visible spectrum.

When an operator wishes to confirm an identity, the two letters shown on the screen are selected from the keyboard: confirmation is shown by a lamp adjacent to the displayed data line. If buttons are added adjacent to each bulb, the action of pushing a button can cause illumination and insert the two data characters. This leads naturally to re-siting the screen from vertical to almost horizontal, which will eliminate fatigue. Where two screens are used, these must be very close to each other. Re-siting certain function buttons leads to a better ergonomic presentation in which colour also assists. Many lists of data contain lengthy groups, each item of which has the same initial letters. A single frame step-on button enables a rapid search through a group to be made. Block check characters, in addition to parity, are required for some installations, especially where transmission lines are involved. Characters for transmission may be held in temporary store until "Ack" is received, as on larger systems. Printed records can also be advantageous. The customer will choose these options or have them as additions to an existing terminal. Each system plan is finally determined by economic considerations.

It is, of course, known that this type of visual display will, within a few years, be superseded by a cathode ray tube with a large internal store as memory. The present cost of such an installation when on-line to a computer is, however, in excess of this data system and if on-line facilities are not available, costs are completely prohibitive.

ACKNOWLEDGEMENTS

Acknowledgement is given to Shell Mex & BP Limited who own the rights of the basic capture method and without whose specification for another data system – ACORN – this derivative would not have been considered. All engineering and design work has been carried out at the Development Laboratory at Ilford and subsequently at Upminster.

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DC Current:	50μA, 0.5mA, 5mA, 50mA, 250mA.
Resistance:	Rx1, Rx10, Rx100, Rx1k
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μF:	0.0001μF ~ 0.2μF

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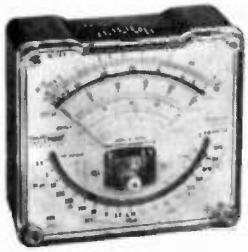
DC Current:	(±) 12μA, 0.3mA, 3mA, 30mA, 300mA, 1.2A, 12A
AC Voltage:	3V, 12V, 30V, 120V, 300V, 1.2kV.
AC Current:	1.2A, 12A.
Resistance:	Rx1, Rx10, Rx100, Rx10k (Max 50MΩ)
dB:	−20dB ~ +63dB

***$45.00**



F-80TRo — Unique Taut Band VOM

DC Voltage:	0.25V, 2.5V, 10V, 50V, 250V, 500V, 1000V.
AC Voltage:	2.5V, 10V, 50V, 250V, 500V, 1000V.
DC Current:	40μA, 0.5mA, 5mA, 50mA, 500mA.
Resistance:	Rx1, Rx10, Rx100, (Max. 50MΩ)
dB:	−10dB ~ +36dB
LI:	15mA, 1.5mA, 150μA
LV:	1.5V

***$32.25**

A-303TRo — Medium Size, High Sensitivity VOM

DC Voltage:	0.3V, 1.2V, 3V, 12V, 30V, 120V, 300V, 1200V.
AC Voltage:	6V, 30V, 120V, 300V, 1200V
DC Current:	60μA, 3mA, 30mA, 300mA, 1.2A, 12A.
Resistance:	Rx1, Rx100, Rx1k, Rx10k, (Max 50MΩ)
dB:	−10dB ~ +63dB
LI:	60mA, 600μA, 60μA
LV:	1.5V

***$25.50**

P-2$_B$ — A versatile pocket multimeter

DC Voltage:	10V, 50V, 250V, 500V, 1000V.
AC Voltage:	10V, 50V, 250V, 500V, 1000V.
DC Current:	0.5mA, 10mA, 250mA.
Resistance:	0 – 5kΩ, 0 – 500kΩ
Volume Level:	−20 ~ +22dB, +20 ~ +36dB
Megohm:	0.1 ~ 50MΩ
Capacity:	0.0002 ~ 0.3μF & 0.01 ~ 0.6μF use external power

***$10.95**

N-301 — Sensitive VOM with overload circuit breaker

DC Voltage:	(±) 0.25V, 1K, 2.5V, 10V, 50V, 250V, 1000V.
DC Current:	(±) 50μA, 1mA, 10mA, 100mA, 1A, 10A.
AC Voltage:	2.5V, 10V, 50V, 250V, 1000V
Resistance:	Rx1, Rx10, Rx100, Rx1k, Rx10k, (Max 20MΩ)
Frequency Response:	50Hz ~ 100kHz for 10V & below. 50Hz ~ 20kHz for 50V & 250V.

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* Prices shown are suggested trade prices which may vary slightly from location to location.

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WHAT'S BUGGING YOU?

(Continued from page 20)

directional that it will virtually ignore traffic and other unwanted sounds. In quiet surroundings the range may exceed a hundred yards.

The best defence is not hold 'confidential' discussions out-of-doors, nor near an open window or door.

BUMPER BEEPERS

Once again, these 'fictional' vehicle tailing units really do exist. One commonly used unit – made in the UK – is powered by in-built nickel-cadmium batteries and operates in various frequency ranges, from 30 to 150 MHz. The transmitter, which is modulated by a pulsed audio tone, is housed in a rugged magnetized metal case. The unit is merely slapped onto any concealed metallic part of the vehicle.

The following vehicle is equipped with an FM receiver – often connected to switchable antennae mounted on the front and rear of the vehicle to provide null-sensing directional facilities.

Apart from their use in espionage, these tailing units are commonly used by security companies to enable following vehicles to keep an unobtrusive check on vehicles carrying valuables.

DOPPLER LASER SYSTEMS

People talking within a room, cause slight air movements that in turn will cause any windows to vibrate at speech frequency. If a laser beam is now directed at the window, the reflected beam will be modulated at speech frequencies.

Several companies are known to be actively working on bugging units using this principle, but as far as we are aware, none is yet in production.

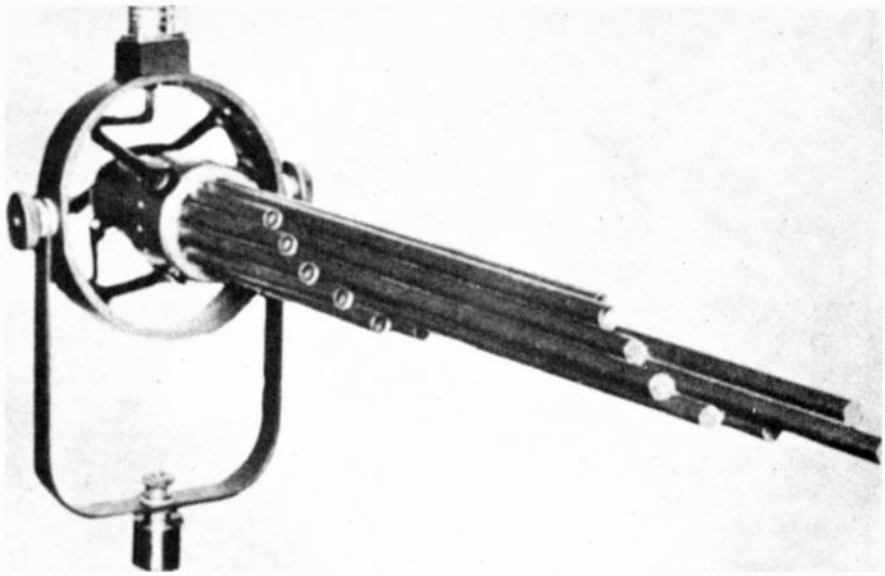


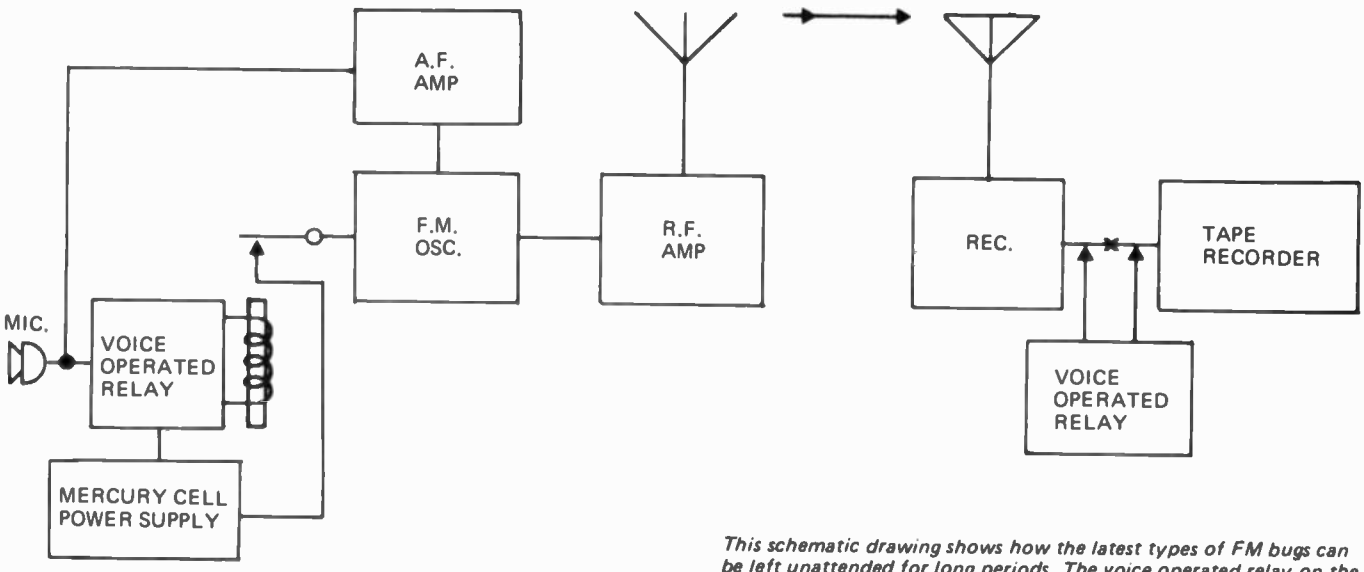
Fig. 10. This RCA shotgun microphone can easily pick up a conversation several hundred feet away despite ambient noise.

IN AUSTRALIA

We have established quite positively, that every item of equipment described in this article has been imported into Australia, or is made in Australia. We know that most people find industrial espionage very difficult to take seriously – it is something that happens in films or only in the USA. But this attitude is naive in the extreme. Industrial espionage is an increasingly grave problem. So much so that in England the Institute of Directors has actually sponsored a book called 'Industrial Counter-Espionage'. In its forward, Sir Richard Powell, Bt. M.C. Director General of the Institute says, "Industrial espionage is a serious subject, far more serious than we suspect."

There is not reason to suppose that it is less so in Australia. ●

All the equipment described in this article is openly advertised and sold – mostly via mail-order – in the USA and UK; many of these items are known to have been sold in Australia.



This schematic drawing shows how the latest types of FM bugs can be left unattended for long periods. The voice operated relay on the left of the drawing connects the power supply to the transmitter only during the time that someone is speaking within the room. At the receiving station a second voice operated relay ensures that the tape recorder operates only during signal conditions.

SHARP 6-CHANNEL PORTABLE TRANSCEIVER MODEL CBT-81

Here is a precision 6-crystal controlled transceiver incorporating the most advanced space-age IC(Integrated Circuit). Automatic Noise Limiter, tuned RF amplifier, dual conversion, center loaded antenna ensure sensitive, stable 6-channel crystal controlled operation even under weak signal conditions.IC miniaturization assures greater portability and increases stability and performance.

FEATURES

- ADVANCED SPACE-AGE IC (INTEGRATED CIRCUITRY)
  All silicon transistorized superior circuitry with tuned RF amplifier, dual conversion and center loaded antenna ensure sensitive, stable 6-channel crystal controlled operation even in weak signal conditions.
- WIDE TEMPERATURE STABILITY
  Advanced silicon transistorized circuit and specially designed components assure superior operation at temperatures ranging from −20°C to +60°C.
- SUPERIOR RECEPTION
  Noiseless, distortion-free sound with adjustable squelch control, automatic noise limiter and mechanical filter ensure noiseless, clear reception.
- SOLID CONSTRUCTION
  Rugged, rain-proof design for all-weather operation. Ideal for mobile or base station use.
- AC-BATTERY OPERATION
  Operates on rechargeable nickel-cadmium batteries or on AC using provided charger.
- ULTRA SENSITIVITY
  Modulation boost circuitry for superior modulation sensitivity and boosting communication range.
- BATTERY LEVEL AND RF-RELATIVE POWER METER ENSURE STABLE OPERATION.
- CALL SIGNAL SYSTEM FOR PRIVATE COMMUNICATION.
- HANDY CARRYING STRAP FOR GREATER PORTABILITY.
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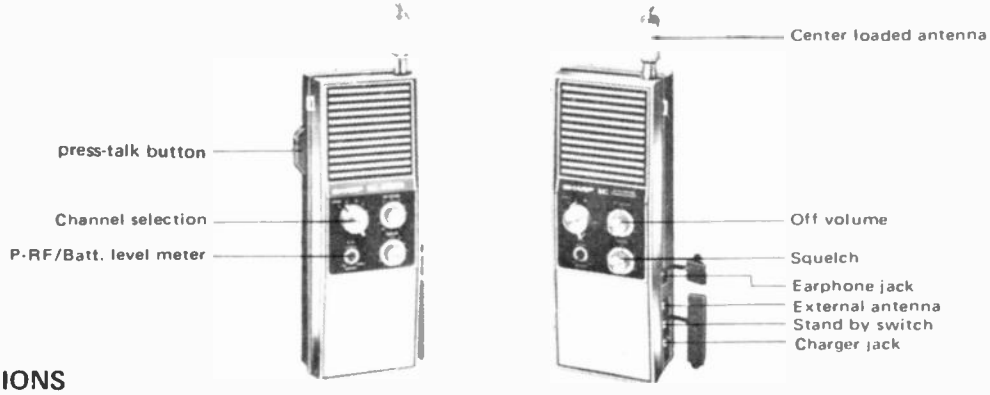

SPECIFICATIONS

Receiver

Circuit:	Dual conversion with tuned RF amplifier, crystal controlled, mechanical filter, integrated circuit, series gated noise limiter, adjustable squelch and Automatic Gain Control.
Frequency:	6 channel in any of 26.96 to 27.27 MHz CB, crystal tolerance: ±0.005%
Sensitivity:	Better than 1.2μV at 10dB S+N/N
Selectivity:	6 dB down at ±2.5 kHz, 40dB down at ±10 kHz
Intermediate Frequency:	1st Intermediate frequency: 4.225 MHz 2nd Intermediate frequency: 455 kHz
AF output:	600mW

Transmitter

Circuit:	Crystal controlled, 2-stage RF amplifier with modulation booster circuit, 4-transistor modulator
Input Power at Final Stage:	3 watts
Range Boost:	Yields high level modulation at average voice level
Carrier Deviation:	±0.005% maximum (at temperatures ranging from -20°C~+60°C)
Harmonic Suppression:	exceeds 50 dB
External antenna:	50 ohms nominal

General

Power Supply:	12.5V nominal (rechargeable nickel-cadmium battery; parts No. 500NICD-5 x 2 pcs.)
Accessories:	Carrying case, earphone pack with earphone, shoulder belt, a pair of crystal (factory installed), 2 pieces of rechargeable batteries, charger (model RC-81 for AC 110 to 120V or RC-82 for AC 220 to 240V, 50/60 Hz), plug (part No. PG-176)
Dimensions:	240mm(H) x 84mm(W) x 55mm(D) [9-1/2"(H)x3-1/4"(W)x2-1/8"(D)]
Weight:	1.1 kg (2.42 lbs.)

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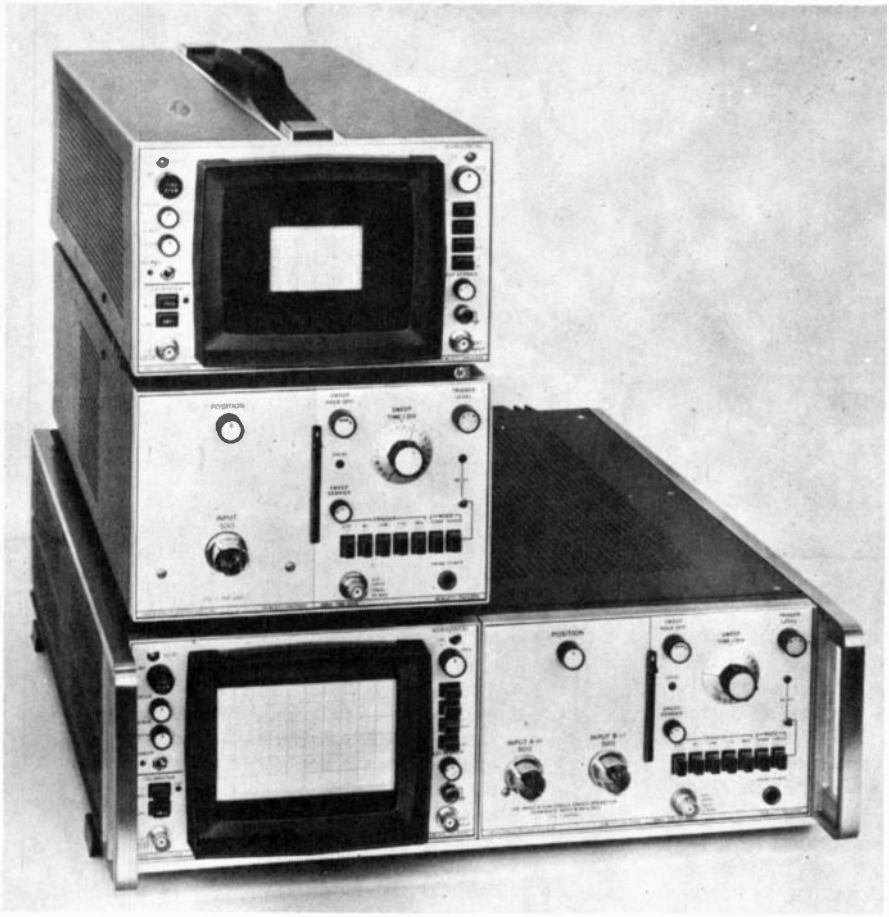
EQUIPMENT NEWS

HIGH-PERFORMANCE OSCILLOSCOPE



A new high-performance oscilloscope is claimed to double its writing speed to 8 cm/ns (As photographed in ASA 10,000 film using P31 phosphor, f1.3 lens, 1:0.5 object-to-image ratio, and pulsed flood-gun fogging.) when configured for a 3 x 5 cm compressed scan. This fast writing speed, the fastest yet achieved in a production scope, is of major importance to scientists working in high-energy physics, to engineers designing advanced computers, and to all others who want to observe fast transients that occur only once, or only at very low repetition rates.

When reconfigured for general-purpose use, the new oscilloscope (Hewlett-Packard Model 183C/D) has a full 6 x 10 cm display area. With either configuration (reduced or standard), this high-performance instrument can use all the plug-ins already designed for the HP 180/181/182/183 family of oscilloscopes. These plug-ins can give it up to 250 MHz real-time response with 10 mV/div deflection factors, 1 GHz sampling performance, four-channel displays, and time-domain reflectometry, among other capabilities.

To make full use of the compressed-scan fast writing rate, a new direct-drive vertical deflection plug-in is claimed to have a frequency response greater than 600 MHz with a deflection factor of 6 V/div. This plug-in (Model 1831A) has a matching network that couples the 50ohm input, either balanced or single-ended, to the 330ohm balanced line that drives the CRT deflection structure. The network also couples in dc positioning voltages. There are no active circuits.

An alternate version of the plug-in, Model 1831B, includes a delay line. This allows the sweep to be triggered by the signal to be displayed. Frequency response of this plug-in is >500 MHz.

To make the mainframe fully operable, a time-base plug-in is also needed; of the several available, the Model 1840A Opt 035 gives sweep rates and triggering capabilities suitable for use with the new 1831A/B direct-drive vertical plug-ins. It triggers stably on signals well above 500 MHz and can generate sweeps with rates as fast as 1 ns/cm (with the mainframe X10 magnifier).

The faster writing speed is achieved by compressing the CRT beam, thereby increasing current density at the phosphor surface. The post-accelerating electrode on the inside of the CRT envelope is now in two sections, with a lower voltage on the forward section. This compresses both the beam and the scan, reducing overall deflection to a 3 x 5 cm area while compressing the beam to less than half the usual spot area.

The normal 6 x 10 cm scan can be restored simply by replugging the forward electrode cable internally to another tap on the high-voltage supply. This allows use of the full scan when any of the several other plug-ins designed for the HP 180-series oscilloscope family are used in the new 183C/D mainframes. This instrument thus has all the flexibility desired of a general-purpose oscilloscope but, by replugging the electrode cable, it can be converted very quickly for fast-writing-speed display of high-speed transients.

An optional version, Model 183C Opt 020, has 10-turn dials on the intensity and flood-gun controls to make possible fast and accurate reset to a previously determined set of test parameters, thus facilitating repeatability in photographic applications. The option also includes 5:1 reduction ratios on the focus and astigmatism controls for very fine adjustment of the CRT spot size.

Full details from Hewlett Packard Australia Pty. Ltd. 22 – 26 Weir St., Glen Inis, Victoria 3147.

NEW RECEIVER

National Radio Company, Inc. of Melrose, Massachusetts announce that their HRO-600 VLF-HF Full-Coverage Receiving System was successfully tested and qualified to the latest version of the U.K. Ministry of Post and Telecommunications "Main and/or Single Sideband Ships' Receiver".

The HRO-600 is the first U.S. designed and manufactured equipment to be so qualified.

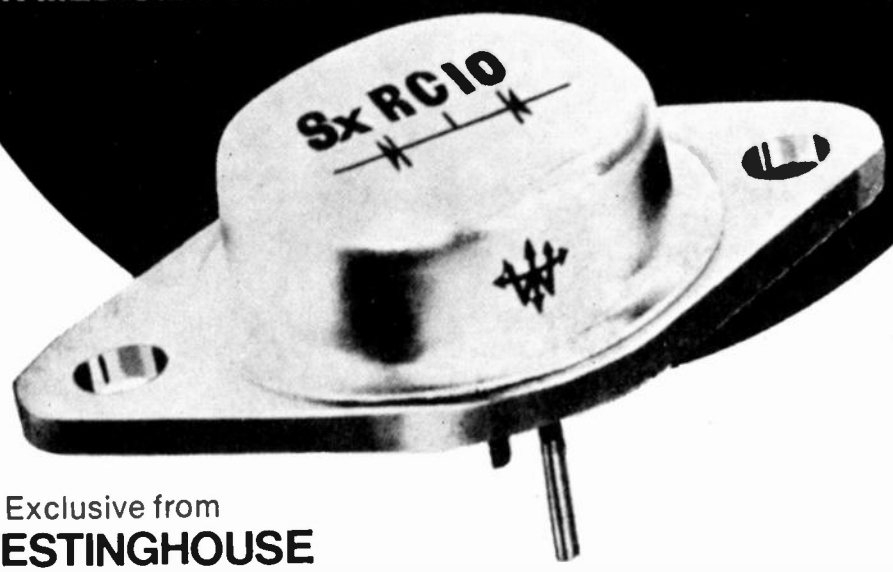
The HRO-600 is capable of operating over the 10 kHz to 30 MHz frequency range in AM, CW, SSB, FSK, FAX modes, and will accept any one of several frequency control plug in units (VFO, synthesizer, fixed channel crystal control). Both the VFO and Synthesized versions were tested and qualified. The design configurations provide for a wide variety of multimode and multipurpose applications. Additional markets for the receiver are: maritime shore stations, air-ground facilities, overseas communications networks, VLF-HF monitor installations, radio frequency control activities and instrumentation programs.

Quantity production of the HRO-600 ic currently underway, and it is expected that the receiver will be available for delivery in August, 1971.

Full details from Auriema (Australasia) Pty. Ltd., Instruments Division, 63 Inkerman Street, St. Kilda, Victoria, 3182.

new centre-tap silicon assemblies

FOR MEDIUM POWER TRANSISTORISED CIRCUITS



An Exclusive from
WESTINGHOUSE

Westinghouse now offer a solution to the problem, so often facing designers of medium power transistorised circuits, of obtaining suitably packaged economical rectifiers. They have developed new Centre-Tap Silicon Assemblies capable of 20 amperes forward current with voltage ratings 100-600 volts. This unique series of double diode assemblies available with either anode or cathode base feature . . .

(1) Enhanced overload to mean current rating ratio which obviates the necessity of employing diodes with a high mean current rating purely to obtain a suitable inrush current capability.

(2) Standard T03 package which permits mounting on normal transistor heat sinks.

(3) Low cost compared with employing conventional diodes.

SILICON DIODE CENTRE-TAP ASSEMBLIES
SXRC10/SXRN10 20 AMP RATING

Cat. No.

S1RC10	S2RC10	S3RC10	S4RC10	S5RC10
S1RN10	S2RN10	S3RN10	S4RN10	S5RN10

NEW LOW POWER SILICON DIODES type SXM3 (also the series 1N5400-1N5408). The diode allows forward currents of up to 3 amperes with voltage ratings of 100-1,200 volts. It is encapsulated in a moulded case which provides a high degree of protection from humidity and high insulation resistance. Axial wire leads form the anode and cathode connections and provide the main thermal path for the dissipation of losses.

PLASTIC ENCAPSULATED 3.0A DIODE
SXM3* AND 1N5400 SERIES

Cat. No.

S1M3 (1N5400)	S4M3 (1N5403)	S8M3 (1N5406)
S2M3 (1N5401)	S5M3 (1N5404)	S10M3 (1N5407)
S3M3 (1N5402)	S6M3 (1N5405)	S12M3 (1N5408)

* PREFERRED TYPE

Other devices available from Westinghouse include Diodes and Thyristors with ratings up to 1,000 amperes up to 3KV.

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A DIVISION OF

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Brisbane:
Holland St., Northgate, QLD., 4013. P.O. Box 10. Brisbane, QLD., 4001. Tel.: 67 1001.

Adelaide:
207-209 Angas St., Adelaide, S.A., 5000 Tel.: 23 1144, 23 1177.

Perth:
Geo. Moss Pty. Ltd., 1014 Woolwich St., Leederville, W.A., 6007. Tel.: 81 2033.

Tasmania:
Hobart: H. M. Bamford, 228 Murray St., Hobart, 7000. Tel.: 34 3781. Launceston: H. M. Bamford, 212 York St., Launceston, 7250. Tel.: 31 4077.

R403

EQUIPMENT NEWS

RELIABLE STATIC INVERTERS

High reliability static inverters for industrial and military applications which are available from a British manufacturer, offer quiet running and constant voltage and frequency.

They are especially suitable for applications in measuring vehicles, in radio and television outside broadcast trucks, in aircraft, ships, tanks and other military vehicles.

In addition the converters are gaining increasing acceptance as no-break power sources for computers, data loggers, communications equipment, signalling and warning equipment, and for critical laboratory equipment.

The inverters are manufactured with a choice of input voltages varying from 12V to 240V. The output voltage is normally 240ac, but special output voltages are available. Operating frequency is normally 50Hz, but 60Hz is available on request.

All models up to 1000VA have input filters as optional extras, but these are built in to models of 1500VA and above.

Most units in the range are fitted into shock-resistant, injection-moulded aluminium cabinets as cooling radiators. Special shock absorbing feet dampen the hardest bumps and shocks.

Depending on the input voltage the efficiency of the various models is claimed to range from 63 to 67% in the 250 VA type to between 75 and 80% in the 5000 VA model.

Further information available from Jacoby, Mitchell & Company Pty. Ltd., 215 North Rocks Road, North Rocks, NSW 2151.

INCREMENTAL RECORDER

An incremental digital recorder designed to fulfil the need for data recording and data logging in a computer compatible format, gives maximum flexibility for systems integration.

The recorder, which has been developed by Britain's Racal-Thermionic Ltd., records data economically and accurately as it arises from experimental work in nucleonics, crystallography, spectral analysis and astrophysics. It is also suitable for use in data acquisition and analysis systems allied to traffic density both in telecommunication and public utilities. It permits easy data handling both for statistical investigation, forward loading projection and cost accounting.

A feature of the recorder is that it is ideal for operation with smaller computers where it can be used as a peripheral or back-up store for which an optional "READ" facility is offered. It is claimed to provide a cheaper solution to this problem than standard peripheral units and to provide an industry compatible record. It may be used as an intermediate store between the source of data and a computer, or as a backing-up store for computer stored information.

The tape is stepped up to 300 times a second in the incremental mode, can be operated at 37.5 in/sec continuously and rewound at up to 200 in/sec but is always protected by the vacuum chambers which maintain a constant tape tension, ideal for storage on standard 10.5 in spools.

The electronic damping system eliminates incremental capstan resonance. Vacuum columns provide optimum tape laying and the proportional spool servo system provides gentle tape handling with dynamic braking, both increasing tape life. Mechanical braking is used solely for parking and emergencies.

The tape path is simple and easy to load, with automatic vacuum-column loading and advance to load point. Operator controls are combined with status indicators.

Full details from Tape Recorders Pty. Ltd., 49-51 York Street, Sydney, NSW. 2000.

SOLDERABILITY TESTER

A British solderability tester records, in one operation, the time to start wetting, the rate of wetting, and the ultimate extent of wetting.

The tester is designed as a link between the production engineer concerned with practical measurement of component solderability, and the researcher into factors controlling the wetting of metals by molten solder. Established tests concern the measurement of a single time-to-wet parameter, or require appraisal by an experienced inspector.

The unit measures the surface tension force between molten solder and specimen and presents it as a function of time while a specimen is immersed in solder.

The test piece is suspended from a transducer-monitored spring system, (whose signal is fed to an oscilloscope or high-speed pen recorder) and the solder bath raised until the specimen is immersed to a preselected depth. Upthrust from the displaced solder gives a transducer-generated signal and this condition is maintained until the solder begins to wet the specimen. The meniscus then rises, producing a downward force on the specimen and a signal of opposite polarity to that of the transducer signal. These first and second stages enable the time to commence wetting and wetting rate to be measured.

Eventually, equilibrium is reached, and the magnitude of the signal measures the ultimate extent of wetting in terms of surface tension and contact angle.

The instrument's three basic parts are a load-measuring system and associated read-out circuitry; motor drive, and associated electrical controls, for moving the solder bath; and a solder-temperature heating and controlling system.

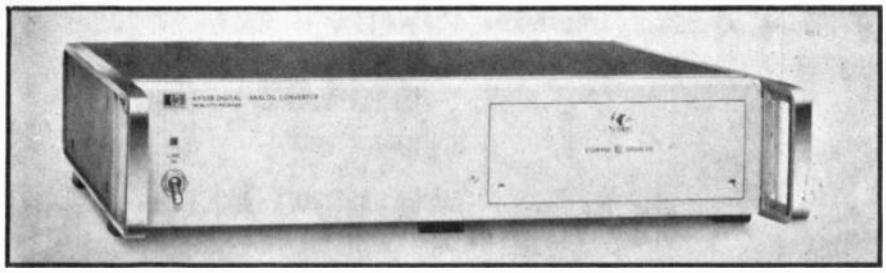
The mechanical movement system needs no adjustment and only occasional graphite grease on the rack and pinion mechanism. A clutch system fitted to the pinion avoids motor damage if the bath system is stalled.

Power requirements are 220-250Va.c. 50 Hz and the tester's dimensions are: height 45cm, width 35cm, depth 30cm. Weight is 50lb.

Full details from GEC-Elliott Automation, 373 Horsley Road, Milperra, N.S.W. 2214.

EQUIPMENT NEWS

SYSTEM INTERFACE



In response to digitally-coded inputs, Hewlett-Packard's new Model 6933B Digital-to-Analogue Converter generates outputs from -9.999 to +9.999V (8421 BCD input), or -16.3840 to -16.3835V (binary input) at 0.10mA. Resolution is stated to be 0.5mV (binary) and 1mV (BCD); accuracy is 1mV; and programming time is 40μsec.

Designed for use in automatic test and control systems, the Model 6933B supplies voltage for testing, or operating voltage controlled devices and instruments. Its output is claimed to behave as a well-regulated constant voltage source, with line and load regulation of 200μV, ripple and noise of 20mV p-p (dc to 50MHz), and load transient recovery time of 10μsec.

The manufacturer states the the Model 6933B meets all requirements for systems use, including:

(1) Isolation between analogue output and digital input, to eliminate ground loops that may impair system operation and damage the computer and instruments.

(2) Internal storage of all digital input data, to eliminate the need to refresh the unit, thus freeing the computer for other tasks. Internal storage also permits several Model 6933B's to be multiplexed from one computer I/O channel.

(3) Flexible, customized, field-reconfigurable interface circuitry, to ensure compatability with any computer, coupler, or other source of digital data.

Programming inputs to the Model 6933B include voltage magnitude, voltage polarity, and gate (encode) signals. Coding for voltage magnitude can be either four-digit (16 bit) 8421 BCD or 15-bit straight binary.

Further information from Hewlett-Packard Australia Pty. Ltd., 22 – 26 Weir St., Glen Inis, Victoria 3147.

NEW TELEPHONE DESIGN

A completely fresh design approach characterises the International telephone now available from Plessey Communication Systems.

Suitable for all private networks, its most radically new feature is the location of the dial between the earpiece and the mouthpiece in the handset.

A valuable contribution to increased efficiency is the quicker dialling obtainable with the miniature dial action.

The novel dial position combines with an extra long tangle-free handset cord to allow the base unit to be placed farther from the user thus reducing clutter in the "busiest" part of his desk.

Greater freedom of movement during conversations results from these features and from the fact that the handset cord cannot foul the switch hook to bring a call to a premature end.

Also contributing to freedom of movement by the user, is the heavy base which cannot slip across the desk.

Another unusual design feature of the International is the disconnect switch provided in the handset, which allows the dialling tone to be obtained at the end of a call without touching the switch hook. In this way it is possible to make consecutive calls using only the handset.

Further information from Plessey Communication Systems Pty. Limited, 87-105 Racecourse Road, North Melbourne, Victoria 3051.

EQUIPMENT NEWS

LOCK-IN AMPLIFIER

A new low-cost high-performance lock-in amplifier featuring completely automatic reference tracking has been introduced by Princeton Applied Research Corporation. The new unit has applications in many facets of engineering, biology, chemistry and general physics.

The PAR Model 128 offers 1 microvolt sensitivity combined with extremely fast and easy operation. All that is required is the connection of a reference signal and the signal of interest, and adjustment of the phase shifter. The unique tracking reference channel is claimed to automatically lock onto the reference signal regardless of its symmetry and completely without adjustment. The signal channel is claimed to offer a flat frequency response from 0.5 Hz to 100 kHz and has low and high pass filters that can be switched in to attenuate noise or signal harmonics. A switch-selectable choice of true single-ended or differential input with common mode rejection of better than 80 dB is claimed.

Available options for the Model 128 include a plug-in tuned amplifier board and internal reference oscillator for use where no externally generated reference signal is available.

Further information from Tecnico Electronics 53 Carrington Rd., Marrickville, NSW.

AUTOMATIC GAUGING SYSTEM

Schaevitz Engineering, (USA) manufacturer of linear variable differential transformers, announces a new development in gauging technology: a multi-channel system which automatically reads and prints out the displacement of 48 individual gauge heads with a system accuracy of ±0.075% over the range of ±0.100". The manufacturer states that the system's scanning speed of 200 channels/second permits use in production applications requiring high volume measurements over a short period of time, while still maintaining accuracy and reliability.

Heart of the system is the Schaevitz gauge head, which has repeatability to 0.000004", and resolution to 0.0000003", and a total error of 0.000050" over a ±0.100" range.

Forty-eight gauge heads are divided into twenty-four inside/outside measuring groups with each set of 2 gauges fixture-placed to measure both sides of the object under test. The difference between the resulting displacements is computed, amplified, and displayed on a digital voltmeter, or BCD output is available for IBM card punch, flexowriter or tape punch for data processing. Optional equipment includes GO-NO GO set point for automatic inspection requirements.

Full details from Ronald J. T. Payne Pty. Ltd., 385-387 Bridge Road, Richmond, Victoria. 3121.

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AUSTRALIAN Tape Record Society offers tape library, "The Microphone" Journal, audio visuals, round robins, tapesondence, sales. Inquiries, P.O. Box 130, Hornsby, NSW, 2077. Please enclose large, stamped envelope.

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CHATTERBOX Recording Club. Full details S.A.E. P.O. Box 118, Wellington. 2820.

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ELECTRONIC components at wholesale prices, valves, transistors, diodes, caps, resistors, meters, solder, circuit board, etc., from Dick Smith (Wholesale) Pty. Ltd., 10 Atchison Street, St. Leonards, 2065. 43-1414, 439-4552. Open Sat. Morning

BOOKLETS, Electronic circuits, suitable for beginners – 45c. Free catalogue of components available, send stamped S.A.E., 21 Hilltop Street, Geelong, 3218.

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COMPONENT NEWS

D/A CONVERTERS

Philbrick's new line of economy digital-to-analogue converters are available in 8 or 10-bit models, with either current or voltage output, and all feature ±1/2 LSB (max) nonlinearity within 1% of theoretical value.

Through the use of microcircuit construction. both high reliability and high performance have been realized. it is claimed, at economical costs.

The current output models, 4020 (8 bit) and 4022 (10 bit) provide 200 nsec typical settling time and the voltage output models, 4021 (8 bit) and 4023 (10 bit), have a maximum settling time of 25 μsec and +5 to -5V full scale output.

All four models it is said, feature adjustment free operation, allowing zero offsets of less than ±1/2 LSB without external trimming. And, full scale output is within 1% of the theoretical value.

A simple jumper connection between pins permits either unipolar or bipolar operation – with no additional external resistors or references required. All models contain internal reference with provisions for using an external reference.

Logic levels are TTL/DTL compatible and provide 0.4V (min) noise immunity when used with standard TTL gates.

All models are 14 and 16 pin DIP compatible.

Full details from Elmeasco Instruments Pty. Ltd., P.O. Box 334, Brookvale. NSW. 2100.

INFRARED SOURCE AND SENSOR ARRAYS

The FPLA700, FPLA710 and FPLA720 source/sensor arrays each consist of a set of two modules: one an array of infrared emitters, the other an array of infrared sensors. The sets were designed for reading punched cards and punched tapes with the sensor outputs operable directly into standard digital integrated circuits. The sets are also well suited, it is claimed, for reflective reading, shaft encoding and multichannel optical coupling applications.

The source module consists of an array of GaAs infrared emitting diodes. When forward biased, these diodes emit an intense narrow band of infrared (non visible) radiation at a wavelength of 0.9 micron. The sensor modules consist of an array of NPN phototransistors which are sensitive to visible as well as infrared radiation (0.4 to 1.2 microns). They are most sensitive to infrared radiation so that the source module's emission wavelength is very nearly perfect for maximum coupling efficiency.

Further details from Fairchild Australia Pty. Ltd., 420 Mt. Dandengong Rd., Croydon, Vic. 3136.

TRIMMER CAPACITORS

A new generation of air dielectric trimmer capacitors characterised by a high order of stability, have been added to an existing range of electrical components produced by Britain's Oxley Developments Co. Ltd.

Known as the SPL9 series, the use of specially formulated modern plastics gives production methods which enable significant cost economies to be made.

The structural rigidity and reduction in the number of solder joints – resulting from electrodes milled from a solid bar – plus the non-hygroscopicity of the insulant, coupled with the company's facilities for testing components for long life and performance, result, it is claimed, in a trimmer of intrinsic excellence.

Alternatives can be supplied for mounting on printed circuits or chassis, and the bases can be colour coded for large contracts.

The company has also introduced two other trimmer capacitors to the range – the PTU/2/V and the TUT/7/V. The PTU/2/V was specifically designed for the U.K. 3. satellite, Britain's first contribution to scientific exploration into space. The sophisticated design and high performance of this product has initiated a demand to meet the growing need for ultra-miniature high frequency trimmer capacitors.

The patented construction incorporates P.T.F.E., and the dielectric and the concentric design ensures uniformly smooth adjustment and completely linear tuning, the manufacturers also claim complete stability under the most severe field conditions.

The TUT/7/V is the latest company tubular capacitor designed for high frequency applications where low losses, low inductance and stable performance are of paramount importance.

The novel patented construction has been calculated to reduce self-inductance to a minimum and the elimination of all soldered joints coupled with the high grade P.T.F.E., dispersion dielectric, all contributes to provide a trimmer with the mechanical ability and reliability to complement the most sophisticated V.H.F. and U.H.F. circuitry.

Full details from R. H. Cunningham Pty. Ltd., 608 Collins Street, Melbourne, Vic., 3000.

INFORMATION DISPLAYS

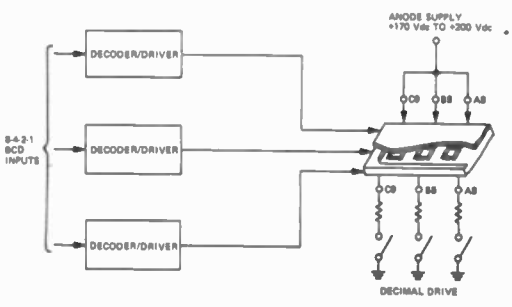
The Sperry SP-73- Information Displays are claimed to offer several advantages to equipment users and designers.

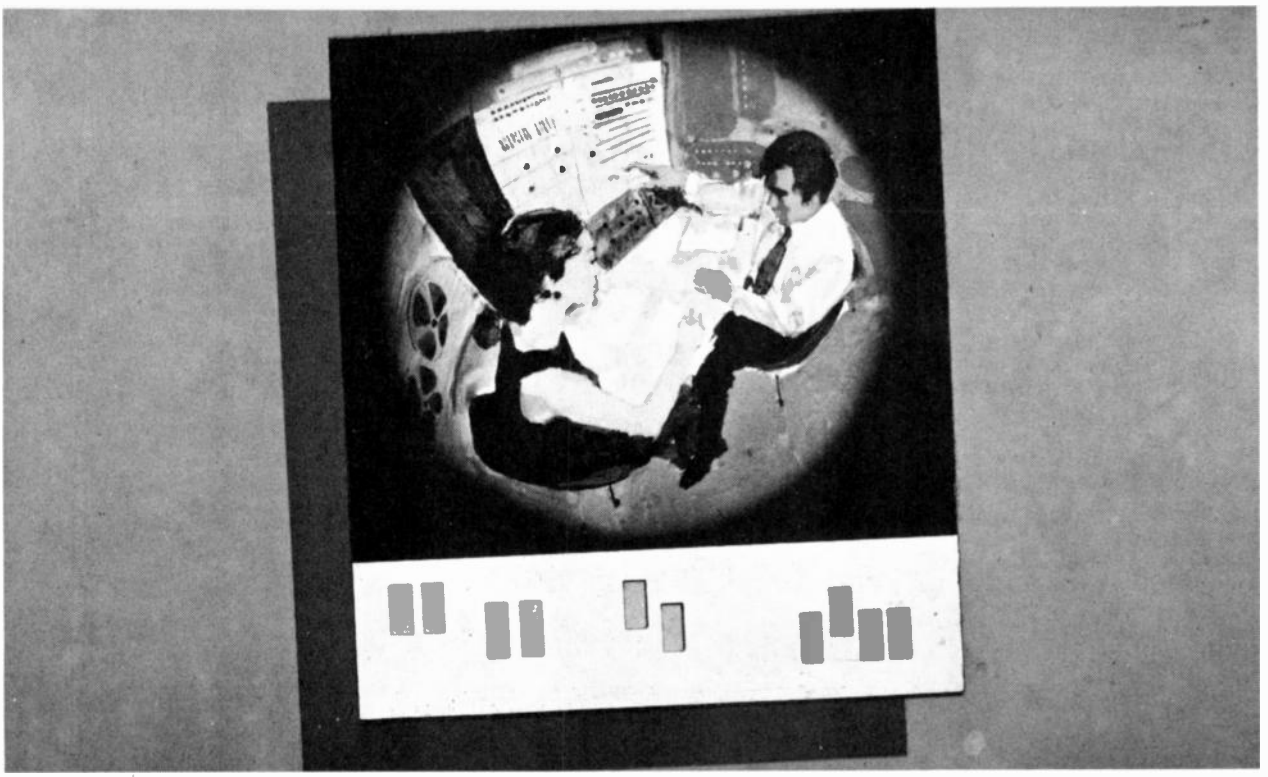
They are compact, versatile, easy to read and cost less. The units take less than half the space of most popular devices on the market today. In addition the 3, 2 and 1½ decade envelopes can be stacked in any variety of combinations while maintaining evenly spaced characters. The manufacturer states that it is the only seven segment display that appears as a solid unbroken digit, and that clarity and uniform brightness are ensured by exacting control of construction tolerances.

It is also claimed that the high intensity display can be read in daylight as well as in any ambient light conditions found in office or factory. In addition a full 150 degree viewing angle without distortion is obtained because all characters are formed on a flat surface.

Further details are available from NIC Instrument Coy., Essendon Airport, Nth Essendon, Vic. 3041.

CONVENTIONAL OPERATION





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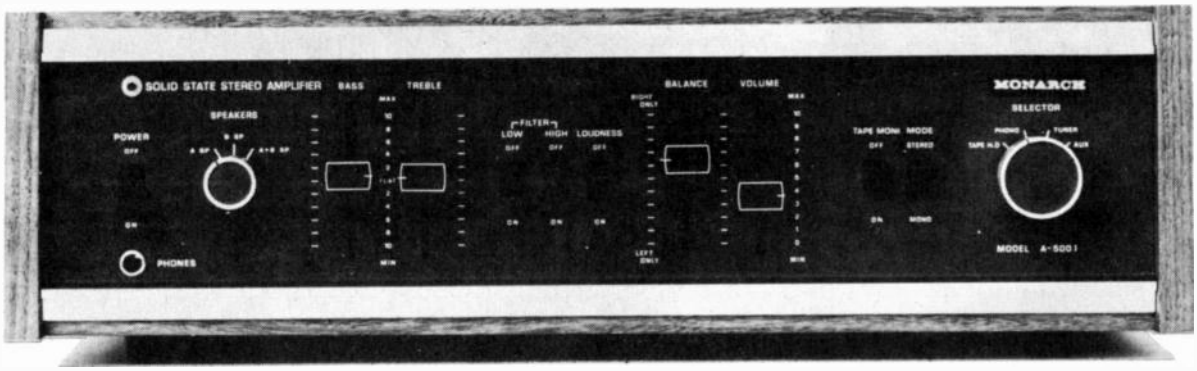

***80 Watts of Total Music Power (IHF at 8 ohms) *Dual-channel IC Equalizer for perfect balance *Special Protection Circuit against over-load *Latest all-silicon transistor circuitry**

Here is the **successor** to the highly rated and successful Monarch A-5000 Amplifier, of which **Australian Hi Fi** Vol. 2 No. 3 stated: **"This amplifier is capable of providing a cleaner transient response than other amplifiers which may be twice the price".**

By popular demand two significant changes in design have been made. Tone, volume and balance controls have been changed to slider types to allow easier visual identification of their settings. New massive heat sinks, thermally joined to the chassis have been fitted, thereby lowering operating temperature and providing even better stability at high volume levels.

The well-designed and tightly regulated power supply assures the total music power of 80 watts (IHF) into 8 ohms. The ability of the power supply is such that the amplifier runs cool with 30 watts RMS each channel operation, without causing current drain to any section of the circuitry even during high level of musical transients.

The direct coupled driver stage, because of elimination of transformers, achieves extremely low distortion. At 25 watts output level the distortion falls as low as 0.2% to produce the pure clarity of sound.

The special protection circuit is proved to guard the driver and output transistors against overload or short-circuit. This is a device to automatically reduce or cut out input signal when overload or short-circuit occurs. It is also automatically self-resetting to permit the amplifier to resume normal operation. An IC (integrated circuit) of a special type, which contains in one single unit a complement of both channel components in equalizer circuit, is used to provide perfect balance of input for optimum stereo.

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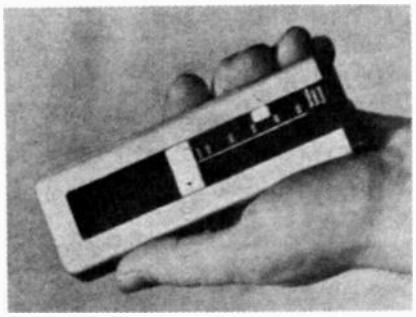
S.A. Sound Spectrum, 33 Regents Arcade, Adelaide. 5000

WD22 11

AUDIO NEWS

SPEED SPEAKING



A recent experimental study has shown that blind people can assimilate spoken data at twice the normal speaking rate. But despite training, few people can articulate clearly, faster than 250 words a minute.

Now the USA's Cambridge Research and Development Group of Bridge St, Westport, Connecticut, have developed a variable speed device that enables recording tape to be speeded up to 500 words a minute without accompanying change in pitch.

It works by a process of removing parts of the waveform in proportion to speed.

Initially the device will be marked for educational purposes – especially for blind people.

AUDIO-VISUAL SEMINAR

A three day seminar is to be held in Sydney next March on Audio Visual Equipment and Techniques. Speakers at the seminar will include the following authorities:–

Dr G. R. Meyer, Director, Centre for Education, Macquarie University.

Mr Neville Smith, Pfizer Labs, and President of Australian Training and Development Society.

Other supporting speakers are yet to be selected.

The Seminar will be led by Mr Kevin O'Sullivan, President of the National Audio Visual Association of the United States.

The program for the seminar is not yet completed but copies discussed are expected to follow the following lines:–

Day 1	"Overhead Projector"
	"Slide Programming"
	"Single Concept Films"
	Panel Discussion
Day 2	"Audio Tape Production"
	"Video Tape"
	"Audio Tutorial Systems"
	"Multi Media Presentation – data retrieval"
	Panel Discussion
Day 3	"Use of A. V. techniques in
	(a) Education
	(b) Industrial Training
	(c) Marketing"
	"Evaluation of Media"

Further topics will be determined.

It is possible that the afternoon of the third day will be given over to talks and discussions on the place of audio-visual techniques in marketing.

The seminar is being held in conjunction with an exhibition by approximately 25 leading American manufacturers of audio-visual equipment. Much of the equipment to be shown has not been seen previously in Australia and some of it is so new that it has not even been on display in the United States.

Neither the exhibition or the seminar is open to the public. Both are designed for executives of organisations with an interest in this field. Admittance is by ticket only. Persons and organisations interested in obtaining tickets for the seminar, or the exhibition, or both, should contact:

The Director,
United States Trade Center,
37 Pitt Street,
Sydney, NSW 2000.

DOLBY IN JAPAN

Dolby Laboratories executives Adrian Horne, Licensing Manager, and David Robinson, Chief Engineer, have just returned from a three week trip to Japan. They were joined during their last week by Ray Dolby and were assisted throughout by their Tokyo office manager, Atsushi Suzuki. During this time the team visited more than a dozen Dolby B-Type licenses in Tokyo, Nagoya, and Osaka, where they discussed technical and marketing questions related to noise reduction.

A high point of the trip was the signing of a license agreement with Sony Corporation. Sony's decision on noise reduction has been awaited in the consumer electronics industry with considerable interest, because of the company's record as a technical and marketing leader.

The Dolby organisation has now licensed Matsushita Electric Company of Japan and its associate companies to manufacture consumer audio equipment incorporating the Dolby B-System of noise reduction. The brand names of the Matsushita group include Panasonic, National, Technics, Victor Company of Japan, Nivico, and JVC. The agreement between Dolby and Matsushita was concluded in Tokyo during the week of January 10.

The decision by Matsushita, Japan's largest manufacturer of consumer audio equipment, follows the licensing by Dolby in recent weeks of Sony, Toshiba, Pioneer, and General. In Japan alone, 20 companies are now preparing Dolby System products to be introduced in 1972 under more than 40 different brand names.

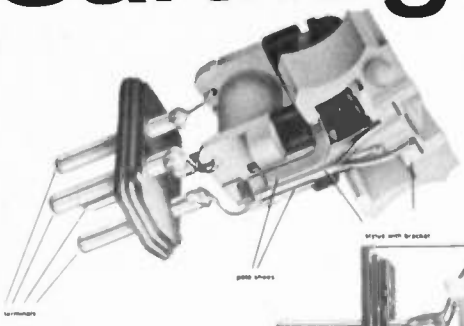
AR PRICES DOWN

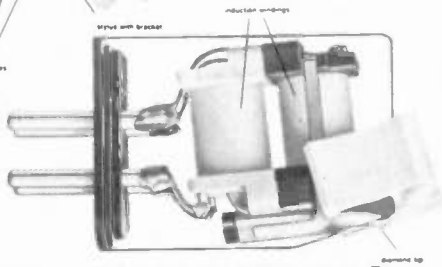
From February 1st the recommended retail prices of all Acoustic Research products have been reduced. In some instances prices have been lowered as much as 12½%.

(Continued page 101)

Hi-Fi Stereo Magnetic Pickup Cartridges

ELAC high fidelity





Hi-Fi Stereo Magnetic Pickup Cartridge ELAC STS 444-12
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Static force 0
Static compliance 33 . 10^{-6} cm/dyne

Hi-Fi Stereo Magnetic Pickup Cartridge ELAC STS 444-E
with elliptically ground diamond stylus. This prevents end-of-side distortion of the upper range of frequencies caused by pinch effect.

Hi-Fi Stereo Magnetic Pickup Cartridge ELAC STS 244-17
Frequency range 20 . . . 20000 Hz
Stylus tip radius 17 um (.0007")
Stylus force 1.5 . . . 3g
Static compliance 18 . 10^{-6} cm/dyne

Hi-Fi Stereo Magnetic Pickup Cartridge ELAC STS 344-17
Frequency range 20 . . . 22000 Hz
Stylus tip radius 17 um (.0007")
Stylus force 1 . . . 2g
Static compliance 25 . 10^{-6} cm/dyne

Hi-Fi Stereo Magnetic Pickup Cartridge ELAC STS 344-E
with elliptically ground diamond stylus. This prevents end-of-side distortion of the upper range of frequencies caused by pinch effect.

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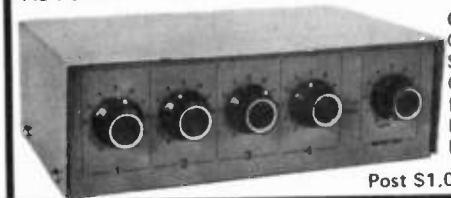

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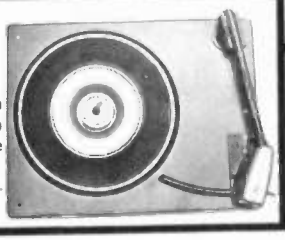

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AUDIO NEWS

(Continued from page 99)

In announcing these reductions, the Australian distributors, W.C. Wedderspoon Pty. Ltd. say that these new reduced prices are made possible by devaluation of the US dollar aided by the high sales volume that has now been rapidly achieved.

As an example, the A-R turntable previously priced at $195 now carries a recommended retail price of $169.

ZERO TRACKING ERROR TURNTABLE

The Garrard Zero-100 tangential tracking auto-transcription turntable has now been released in Australia by Plessey Ducon.

The unit, which is also available in a single play version, incorporates a zero-tracking error pickup arm which won Garrard the "Maker of the Microphone" award in the United States.

European recognition of the Zero-100 came in the form of the Italian "Mercurio d'Oro" award given for "contributions of particular value to European and world economy".

Second harmonic distortion, say Garrard, is one of the last significant barriers to completely faithful sound reproduction from disc.

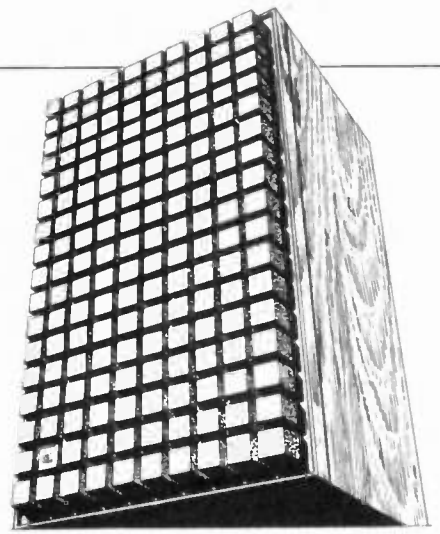
The Zero-100 approaches this problem in a way which as well as being technically effective is also simple to use and visually pleasing.

The tangential tracking method which it employs, though straightforward in principle, imposes extreme standards of engineering accuracy. These have been met by computer-aided design to optimise pickup arm geometry, and by the use of highly specialised components which overcome the critical friction problems inherent in such a system.

The Zero-100 pickup arm is designed so that the cartridge housing is pivoted directly above the stylus tip. The degree of pivot is controlled by an auxiliary articulating arm, the effect of which is to maintain the pickup head at a virtually constant tangent to the record grooves across the entire playing surface.

We are currently arranging to review this unit, and our full report will be published in ELECTRONICS TODAY very shortly.

Come hear the new JBL Century and take home the music.



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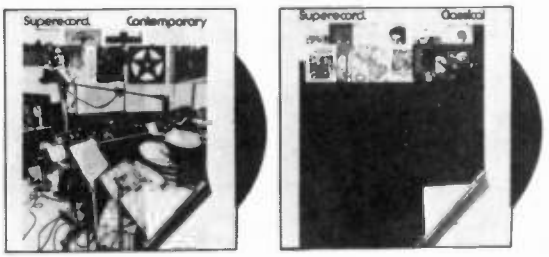

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AU118

RECORDINGS... CLASSICAL

REVIEWER: John Araneta

RAVEL – Daphnis and Chloe suite No. 2, Rapsodie Espagnole, Pavane, Alborada del Gracioso, Boulez, Cleveland Orchestra CBS SBR 235446

Boulez's analytical approach to Debussy scores can be most effective: his La Mer is certainly one of the most moving and original interpretations to be heard. But the approach does not benefit all Debussy scores. His recent Nocturnes, for instance, are a disaster of calculation in my opinion.

Boulez does tend to rob Debussy scores of their mystery. There is quite simply a great lack of "feeling" in his approach, although no doubt Boulez would dislike the use of that particular word. Debussy's scores may be clear, and almost mathematical at first sight, but they do leave a lot to the performer.

With most Ravel scores, however, it is an altogether different matter. Ravel was remarkably explicit in his scores, as he himself liked to admit, and while I am not limiting Ravel's achievement to orchestral brilliance, nevertheless a technically precise performance with full attention to points of balance can be enough, in my experience to bring off most of the orchestral scores with great effect. Or perhaps I should not use the word "enough". Perhaps it is just that substance and form are so often completely wedded together in most Ravel scores, and I am not suggesting they are superficial.

Quite predictably then, Boulez's performance of the Daphnis Suite No. 2 is definitely one of the most moving and effective performances I have ever heard. His attention to orchestral details and balance of chorus and orchestra is hair-raising. Comparison in this instance with his recording of the Debussy Nocturnes is instructive. In the Debussy he is, as usual, aware of the subtle rhythmic figures, of the general craft of Debussy's score but the ultimate effect seems flat by comparison with his performance of the Daphnis extract here. Similarly, in the Alborada, the outcome is stunning and yet nothing seems mannered and exaggerated. Indeed the more departures one makes with Ravel scores, the more superficial they sound. In the Rapsodie Espagnole, Boulez, laudably, does not hesitate to inject feeling where he feels this necessary for this score is rather different from either Daphnis or the Alborada. It is closer in spirit to Debussy, impressionist, and the score leaves more to the performer. There are times when one wishes Boulez were still a little less reserved but this may well be a matter of individual taste.

The only disappointment on this record is the Payane. This lovely music harks back to the more traditional manner of a faure, and Boulez here is not comfortable with the music. But one must really listen to the rest of the playing on this disc. The Cleveland plays marvellously for Boulez and the singing of the choral portions of Daphnis is superb. Very well recorded. I would strongly recommend this record. – J.A.A.

MASSENET-MANON (Original Version). Sills, Gedda, Bacquier, Souzay, Ambrosian Opera Chorus New Philharmonia Orchestra, Julius Rudel (conductor). 4-HMV SLS.800/4.

Despite a dearth of French opera on records, it must be admitted that Massenet has been fairly well served by some gramophone companies – and doesn't somebody especially at EMI love French opera? To EMI we owe rather splendid recordings of (alas) excerpts from Herodiade and Thais, and a fairly good, complete Werther. The same company also gave us an excellent, near complete Manon some twenty years ago, and I can still recall the surprise of most critics at the mere fact of its release, so unfashionable French opera was and still is. True, one wishes EMI had given us complete recordings of the abovementioned Herodias and Thais and where is Cleopatre, Sapho, or Esclarmonde (Massenet's own favourite)? But perhaps if this new recording of Manon is any indication a more favourable view of French opera may yet be in the offering, and one cannot be ungrateful here, after all we do owe most of the respectable performances of French operas, even other than those of Massenet, to EMI.

The Monteux-directed Manon (still available on American Seraphim) has served well so long that any new set necessarily invites comparison with the older. That venerable recording had a great Manon in Victoria de los Angeles and conductor Pierre Monteux *inspiring* everyone concerned. Well, this new recording does not eclipse Monteux's achievement but it is a very fine performance indeed.

To begin with, this recording attempts to approximate Massenet's original intentions. We are given the original ensemble finale to Act I (unquestionably the most important resoration), a complete Entr'acte to Act III, and the Act III Fabliau sensibly included as an appendix at the end of this recording these among other restorations not to be heard in the Seraphim Manon.

Conductor Julius Rudel is no Monteux but he does love this work and is generally more careful about details. Because of the undeniably better recording we are also more aware of how subtle is Massenet's writing for the orchestra and Rudel takes care to emphasize its use particularly with regard to the psychological development of characters (an idea not commonly associated with Massenet's operatic achievement). And how Massenet's orchestra continually underlines, develops, sings: never a dull moment in this very great score. I thought, however, that certain loud passages, especially the opening to Act I seemed ragged but this may very well be due to faulty balances.

Beverly Sills as Manon does not posses the beautiful seamless tone, de los Angeles gave to the role, nor the rather wistful pathos which is very much a part of the tonal quality of that voice, but she is very much the fine actress and the thinner girlish quality – never just simply naive sound – she delivers is very appropriate. It is mainly to her credit that this supposedly faded story comes humanly to life. To my mind, Sills here is most moving in the first Act and especially when she is joined by Gerard Souzay (des Grieux). The latter, sounding now a bit vocally frayed, nevertheless triumphs over his present limitations by a never failing artistry and elan (what beautiful French): in the first act alone Souzay manages to reflect every turn of the Chevalier's character – when he appears drunk he is quite believable without any trace of sham. The rest of the cast is very fine indeed and always at least on a par with those in the older set. If I have singled only Sills and Souzay it is simply because their performances are definitely outstanding.

Recording is quite good with the exception of loud passages from orchestra alone when everything does tend to sound ragged. Oddly enough the large ensembles with chorus sound quite acceptable. Dramatic effects, "stage noises" are used to good effect and never to my mind exaggerated, but I do wish a better idea of space had been conveyed: Des Grieux sings from a tavern admittedly close by, in Act I but his voice sounds as much in the foreground as other voices *outside* the tavern with the result that his later appearance hardly comes off with the desired effect.

All in all, a very exciting recording, and inasmuch as EMI is offering this recording at the moment at the special price of $14 for four records, this set even competes with the older mono Seraphim (import only) as to price which should encourage more people to get acquainted with this great work.– J.A.A.

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Dimensions: 12½"W x 9"D x 3¼"H.
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The Dolby B system employed in the Harman-Kardon CAD5 operates on both record and playback. It boosts low-level high frequency signals prior to recording, then attenuates these same signals in a precisely equalized mirror image during playback. When this is accomplished, all of the additional noise that may have been added after the fact is reduced to a level below audibility.
Harman-Kardon, long an industry leader in advancing the state of the art, has made the Dolby noise reduction process an integral part of the new CAD5 tape cassette deck. The result is an incredible boost in bandwidth and dynamic range.

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CLASSICAL

BIBER – Battalia, Ballettae, Peasants' Church Procession, Sonatae – Nikolaus Harnoncourt, Concentus Musicus Vienna Telefunken SAWT-9579.

There is already a surprising and varied amount of Biber's music on records despite the fact that we know little enough about the man to make us unable to date his works with any accuracy. We do know he was a virtuoso violinist and also director of the orchestra in the Bishop of Olmutz's court. He was perhaps the first composer to use scordatura, that is, tuning a stringed instrument to other than normal notes for effect. In his orchestral and instrumental writing the violin possesses a solo quality that must have been quite a novelty for its time. Otherwise this writing is always colourful and vividly programmatic with folklike rhythms and tunes.

This record is in many ways an excellent illustration of the variety in Biber's writing. For actually unnerving scordatura and realistic writing one need only listen to the Battalia: a musical depiction of the revels, marching, and duelling of drunken musketeers. Alongside this, almost every other musical joke sounds contrived.

In the Sonatae a violae we hear the virtuoso qualities of Biber's strings. The Sonata a 7 with its six trumpets divided into good, middling and lazy players give us a good idea of the high calibre of the brass section of Biber's orchestra, which included Pavel Vejvanowsky.

In almost every respect, Harnoncourt's group play well, hardly failing to convey the humour of the pieces in a natural and spontaneous manner. In the case of the Sonata a 7, however, I sometimes find it hard to distinguish between the good, fair and bad trumpets. It is sometimes said that baroque trumpeters, however good, could hardly be expected to play with the same exactness of their modern counterparts. A piece like this goes a long way to refute that idea and makes us realize only too clearly that modern players of baroque trumpets have yet to attain the proficiency with their instrument someone like Vejvanowsky undoubtedly possessed. – J.A.A.

SIBELIUS – Violin Concerto in D minor, Op.47
TCHAIKOVSKY – Serenade Melancolique, Op.26
TCHAIKOVSKY – Scherzo from "Souvenir d'un lieu cher", Op.42/2
Ricci (violin), Olivin Fjelstad, London Sym Orch SDD 276

This altogether distinguished account of the violin concerto is unfortunately handicapped by the wretched pressings I have come across. The sound on this record is thin, tubby, and the end of the first side and climaxes in general are very distorted indeed. This is surprising in view of the fact that local EMI pressings have come a long way from what they used to be especially in view of the fact that import English EMI and DECCA pressings have deteriorated in the last year or so. I certainly hope this disc will not be a sign of things to come.

A pity, since this record is especially interesting for Fjelstad's tempos, and throughout the recording Ricci is for once generally in pitch, although he does find the last movement somewhat hard going, as who does not? Also, this record includes two charming Tchaikovsky pieces not easy to come by these days. But for those who can locate a satisfactory pressing, this record makes a very good buy for $4.50. Otherwise there is the readily available DGG performance with Ferras and Karajan that is splendid. – J.A.A.

ANTON WEBERN – Slow Movement (1905), String Quartet – (1905), 5 Movements for String Quartet, Op.5, 6 Bagatelles, Op.9 String Quartet, Op.28, Quartetto. Italiano. Philips 6500 105.

The neglect of Webern's music on records is a mystery to me. In view of his eminence and his all pervading influence on most of the composers of the last thirty years the point raised is almost a moral one. So we get recordings of so many of his spiritual descendants, most of whom are devoid of originality and interest and yet the master is still quite unaccessible. The problem here is not the fact that recording companies would hardly consider Webern an attractive economic proposition. Neither Hindemith or Schonberg are, and yet a glance at the Schwann or Grammophone catalogues reveal these composers are far better represented on disc than Webern is. True, the Craft set of what was then known as the complete work, and which was rather briefly available here on PHILIPS is still listed as available in Schwann and French Diapason catalogues but it is almost impossible to obtain a copy of the set outside America and even there it is available only directly from (Am.) Columbia. Surely a better effort can be made today, now that orchestras and singers are more attuned to the idiom. Quite a few of the performances on the Craft set sound like hopeless run-throughs, as Craft himself candidly admits in the brochure which comes with these records.

Well, here is a very fine recording of Webern's string quartet music. On this disc one can readily appreciate the remarkable development of Webern's style from the neo-Brahmsian to the masterfully abbreviated style of his later years. The Quartetto Italiano evidently have these works in their bones, they are precise and always very moving. The colours they get in the OP.5 and OP.9 are remarkable in the extreme. Very well recorded. One must have this disc. – J.A.A.

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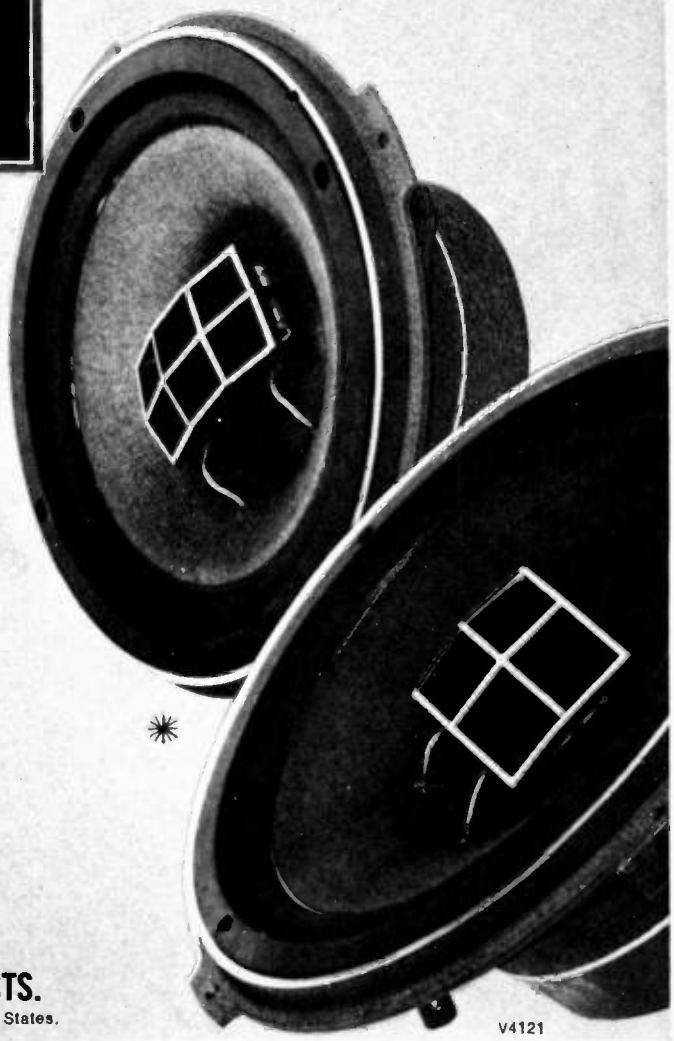

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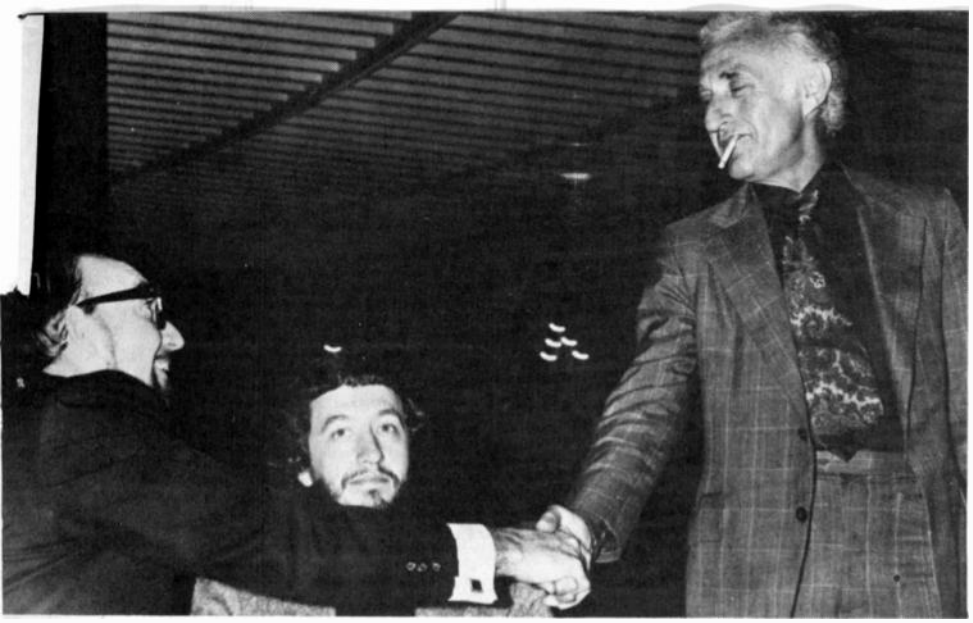

Internationally respected American bassist, Jack Lesberg, (standing) talking with Ed Gaston at the 'Wentworth Hotel Supper Club'. Musician in centre is New York arranger Bill Motzig – late sound man for Blood Sweat and Tears.

TALKING JAZZ with Jack Lesberg

This feature article by Trevor Graham replaces our normal jazz record reviews this month.

American bassist Jack Lesberg has settled in Sydney, for an indefinite period. His first engagement was to deputise for Ed Gaston at Sydney's leading jazz spot, the world renowned Wentworth Hotel 'Garden Court Supper Club', as bassist with Australia's most respected jazz group, The Don Burrows Quartet.

Jack Lesberg has toured with many of the legendary names in jazz including Louis Armstrong, Eddie Condon, Jack Teagarden, Earl Hines and Benny Goodman. He has also played with Jascha Heifetz and Isaac Stern in addition to performing under the musical direction of Arturo Toscanini from 1945 to 1947 as a member of the NBC Symphony Staff Orchestra.

From 1947 to 1950 he played the first stand for the New York Centre Symphony at the time when Leonard Bernstein took over the conductorship from Leopold Stokowski, and often at the end of his concerts he would rush down to the Village, to Eddie Condon's club, and take over after the first set; frequently with Bernstein in the audience!

A freelance studio musician in New York, prior to flying to Australia, Jack Lesberg has recorded with many of the great vocalists in the recording business. He was a performer at the first Newport Jazz Festival and was invited to return by promoter George Wein, for 12 subsequent years. Also as a member of Wein's Newport All Star Groups he has toured Europe, Mexico, Canada and the United States extensively.

Among the highlights of Jack Lesberg's career was the Town Hall Concert with Billie Holiday and also his playing at her last public concert, which was held at the Phoenix Theatre on New York's Second Avenue with Dick Hyman on piano and Jo Jones on drums.

Trevor Graham met Jack Lesberg several days after his arrival in Sydney, Australia, and recorded the following conversation.

T.G. – What instruments have you brought with you?

J.L. – I have two wooden basses, one of which is very old – possibly 200 years – and is a very beautiful sounding instrument. For me an instrument has to respond, and this bass just responds so nicely. The other bass is either Czechoslovakian or German and is very sturdy, it is very good for touring with as it has a penetrating sound and is excellent for playing jazz.

I have also bought a Fender. The Fender I got involved in four years ago out of consideration to my studio and T.V. clients in New York. A lot of guys like myself had held out till the end, while others had jumped in early – and maybe the latter were smarter financially!

To me, the Fender is a personal dislike because it is just a hunk of wood. I mean it is just four little magnets and you could hook them onto this table, string some strings along there, and if it has got a neck of some kind – a broomstick would do – it is going to make the same sound.

The instrument is completely electronic and I have no personal feel for it. I mean, take the volume: if you want to get louder or softer you just turn a knob, it is not really a matter of creating a feel. Sure, you can play certain notes, but there is no personal satisfaction for a bassist.

T.G. – Personal satisfaction?

J.L. – That's the answer! Who are you going to satisfy? You have got to start with yourself. If you can't do that you might as well sell bananas!!

There are lots of ways of making a dollar, but I've always liked playing the bass, and have been able to make a comfortable living from just being a sideman. So I can't imagine myself doing anything that in some way didn't involve my keeping my basses.

Let me assure you that when I take the cover off my bass, I intend to play the behind off it. So this gig with the Don Burrows Quartet is a sort of unexpected pleasure, and it was a very pleasant surprise as I had only met Ed Gaston this past March when, while on a tour of Australia, I dropped by the 'Wentworth' to hear Don's Quartet.

T.G. – How pre-planned was this move to Australia?

J.L. – I had planned to come to Australia about this time although before I left the States I had been on the road with Sy Oliver for a month and had also done a two weeks tour of the Mid-Western States with Daphne Hellman, the harpist. But my actual decision to move had not been made till the Monday prior to leaving the States.

When I arrived in Sydney I looked up promoter Kym Bonython, who has been a friend of mine for 20 years and is now in partnership with George Wein arranging jazz tours. I also tried to find pianist Dick Hughes and Dr Clemment Semmler, an executive of the Australian Broadcasting Commission who is also an old fan and friend.

T.G. – Why Australia?

J.L. – I've always liked the country. My first impression, when I toured Australia with Louis Armstrong in 1956, was favourable, and on each

TALKING JAZZ

subsequent visit I confirmed that impression. That 1956 trip was my first outside the United States and at that time I was doing 12 or maybe 14 studio sessions a week in New York, and for several years had not even got across the bridge to New Jersey.

T.G. – Has the pressure of New York got too uptight?

J.L. – Yes. New York has gotten a little thin, and a little tiresome with the struggle of just trying to exist, as everybody has their hand out and everything is for the fast buck. I don't expect to make anywhere near as much money as I made in New York, and realize some adjustments will have to be made in that area. But I have a beautiful flat and a garden with trees; it's a more personal existence and it makes a lot more sense than just making a whole lot of money that doesn't mean a thing.

I just feel that in Australia I can get more of that self satisfaction that we discussed earlier. Take last Sunday: Arch McKirdy, called around and we played 18 holes of golf, then I went home, collected my bass and dropped by pianist Julian Lee – and within two minutes Julian was jumping all over the piano, and I was jumping all over the bass. Drummer Warren Daly, who has worked in the States with the Glenn Miller Orchestra and Sy Zenther, came along, and we really exhausted ourselves. So maybe there is some contribution I can make to your music and music education scene.

T.G. – Many jazz musicians in this country who become involved in music education, have a background of classical interests.

J.L. – Not just in Australia – I've had at least as much a background in the classical area, as I have had in jazz. As a matter of fact that is where it all started.

I had played and studied violin and viola for a number of years before I got to the bass, and was with Leonard Bernstein for a long time in addition to several years with the NBC Symphony.

T.G. – Outside of jazz tours, what has been your main activity in the States?

J.L. – Generally back in New York I freelance for T.V. and commercial recordings. I have recorded with people such as Ella Fitzgerald, Billie Holiday, Frank Sinatra, Sarah Vaughan, Perry Como, Patty Page, Buddy Clarke, Eddie Fisher and Pearl Bailey.

In the States you always do as much work as you can, as long as it makes some sense. I have always freelanced and have not had a steady job in probably twenty or twenty five years, outside a one day call for a weekly radio or T.V. show. Studio work in the States has always been competitive, and freelance players have always had to be very specialised and on the ball. There exists a certain decorum in this type of employment – a professional responsibility to the person who calls the session.

T.G. – Has studio work changed in recent years?

J.L. – Studio work has changed, it has deteriorated slowly through the years. Tape recording has reduced the amount of time that producers had to hold musicians in the studio, and now with 8 and 16 track machines they can intercut whenever they want to, and, so the sessions are now done piece by piece. The American economy has also had its depression, or inflation, or whatever you want to call it, and it has gone badly for musicians the past few years.

The union scales have been raised so high that musicians have almost outpriced themselves from the advertising and film companies. Now these companies quite often only cut the rythmn track in the United States and then send the arrangement over to England or one of the Scandinavian countries, and get fine musicians there to pad the sound.

T.G. – Your observations on the jazz club scene in the States?

J.L. – Clubs are a changing aspect of the American scene. When I first came to New York I opened Eddie Condon's club Xmas 1945; Max Kaminsky, Dave Tough, Brad Gowens and Pee Wee were in that band. 'Nicks' and 'Jimmy Ryans' were also very popular at that time.

But, comparing that to now? Well, 'Jimmy Ryans' does still exist on 54th St. and a lot of little clubs down in the Village use trios, but the cost of going to a jazz club in 1972 is another part of the problem confronting everybody interested in jazz in the United States.

T.G. – Would you like to tally the total cost of an evening at a 'Name' jazz spot in New York?

J.L. – I was in the 'Roosevelt' Hotel for six months last year and they had some really good things happening. I played in Joe Venuti's group and Bobby Hackett's group – but it was just financially impossible to drop by very often.

You would walk through the door and there was a $3 or $3.50 cover charge; so if you brought company it was $7 just to pass the door. Then if you had a couple of drinks each, at $1.75 – there was another $7. Add to this $5 or $6 for car parking and you were up to $20 and you still hadn't eaten! So being very careful, and diving under your table if you saw

(Continued on page 120)

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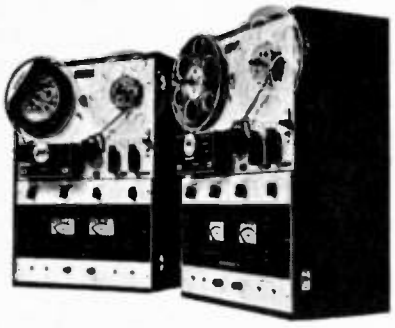

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RECORDINGS... POP TRENDS

REVIEWER:
Michael Delaney.

HIGH TIME MC5 Stereo. SD. 8285

MC5 is a volume band – yet another example of the American noise machine along similar lines to The Amboy Dukes and The Stooges. They're loud, repetitive and ultimately monotonous. This Detroit quintet bases its entire impact on the near malefic energy levels. Their approach is raw, undisciplined and cliched-beyond-compare. They seem to hold a great deal in common with the old Blue Cheer circa '68 as far as basic structure is concerned. Melody is incidental.

MC5 demand complete physical involvement very much in the vein of Grand Funk Railroad. Their music is an awkward mixture of riff-rhythms and cacophonous drums –rock'n'roll at its most destructive. They rely heavily on feedback and studio dynamics to generate atmosphere. MC5 sound amateurish. There's an absolute lack of unity, balance and inspiration throughout each of the eight tracks. It's all too brash and luck-lustre. They appear to be hopelessly encased within sheer amplification.

MC5 rate as the most unadventurous hype yet to emerge from the Kinney stable. They're hustlers without style or variation. Over & Over and Sister Anne barely highlight the disc. Production is lifeless. Fred Smith, Wayne Kramer and friends remain the stateside masters of mediocrity. Their 'kick-out-the-jam' promotion key never quite made the grade. Bad news. – M.D.

"BYRDMANIAX" – The Byrds. Stereo. SBP. 234000.

You've really got to hand it to the Byrds. Despite innumerable changes in both line-up and direction they have always managed to retain their central character. This band refuses to compromise on any level. They are innovators. Their music is so good mainly because the Byrds as individuals are so good. You don't come across something like this very often. Whether your admiration is based partially on nostalgia or a genuine love for the current is immaterial. No matter what the Byrds happen to record – you can bet that it'll turn out as darned near perfect every time.

This is much the case with album No. 12 – a fine bunch of songs collectively tagged "Byrd-maniax". They've progressed further away from straight country in an effort to show the composite personalities behind the 'group' sound. McGuinn contributes "Pale Blue", "I Trust" and the haunting "Kathleen's Song". He follows a less rigid regard for style and thus loses that harshness so apparent on the last three albums. He seems satisfied with odd little ballads. Clarence White & Gene Parsons give us a rollicking instrumental by the name "Green Apple Quick Step", whilst Skip Battin comes along with the lyrical "Absolute Happiness" and "Tunnel Of Love". Needless to say, it's all still there: the harmonies – fourths, fifths; the double guitar solos and the contrapuntal bass. The Byrds have moved passed the stage where they could ever lose these basic requisites.

"Byrdmaniax" transcends much of the offel thrown together under the guise of rock'n'roll. Each song possesses a glowing melody continually under-played. There's little need for production gyro-gymnastics to heighten the sound. The Byrds play the whole thing with very few trappings other than the occassional string section. The album generates an incredibly close, if not intimate atmosphere that carries throughout every track. Listen to the trad-country heartache within "My Destiny". Compare it to the soaring vocal climaxes and the general sense of order in quality of "Byrdmaniax". The mix is quite exceptional as is the engineering. Everything has been completed in moderation. This cannot help but complement the subtlety of the band. The Byrds continue in their role as the elder-statesmen of American rock'n'roll. – M.D.

"SIGNS" MGM Stereo. FXLP. 2315.060

Five Man Electrical Band adheres to convention. They're strictly entertainers. They try to cultivate as broad a market as possible without debasing the current Top 40 status. The group is commercial – immediate melody backed by competent performance. Their appeal is that enjoyed by the average stateside chart outfit. Recognition is transitory. This Canadian team suffers from a somewhat nondescript character. They lack definition. Five Man Electrical Band tends to over-react. There seems to be very little sense of dynamic contrast outside the occasional rhythm interplay.

The influences range between country-blues and funky gospel. They play amorphous rock'n'roll centred on staccato guitar riffs and heaving keyboard. "Signs", "Swamp Woman" and "Butterfly" promise a technical standard that is otherwise unattained. "Safe & Sound" is reminiscent of a poor man's Three Dog Night. The remainder of the material draws varying degrees of comparison with either Creedence Clearwater Revival or The Band.

This group requires a pronounced direction. They have a sensitivity and flow that is wasted due to the lack of positive goals. Five Man Electrical Band can be quite compelling once they realize the effect of relative approach. Each member is an accomplished musician and vocalist. Les Emmerson – leader & chief songscribe – possesses a natural skill with arrangement and presentation that could well prove to be the one major strength behind continued disc success. The over-all sound is clever. The band manages to avoid most of the old cliches that haunt all forms of semi-religious rock. They have developed an articulate nucleus that needs to be expanded.

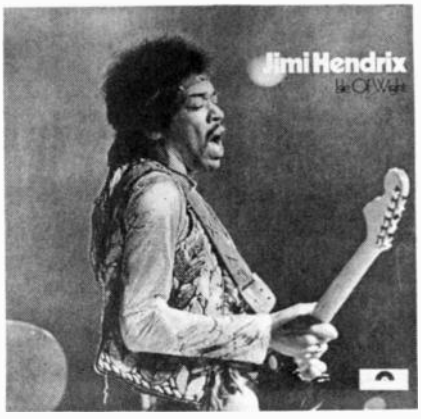
Emmerson has a way with time changes that rarely fails to intensify both mood and excitement. He uses the guitar/keyboard section in a series of fat, chunky bursts to illustrate the various themes. He's quite an ingenious guy. Production could be better. Separation is poor. – M.D.

"ISLE OF WIGHT" Stereo. polydor. 2310.139.

Jimi Hendrix was a star – the freak guitarist complete with spangled pose and gimmick. He tried to give the kids a glimpse into the basic allure centred on rock'n'roll. It was really quite straightforward. Jimi Hendrix had style. He reintroduced animal instinct. It was all a matter of image versus appeal. He possessed charisma. This was something worthwhile for the kids to scream about. He wasn't the boy-next-door. It was showmanship and the art of suggestion.

Hendrix was a super-star. He believed in his music. It was melodramatic and high-camp; outrageous and unpredictable. He had to become a cultist hero. His instrumental agility was breathtaking. This was the essence of modern theatre – extravagant; ultra physical. Hendrix rapidly developed into his own musical paradox.

POP



Simply this: Hendrix was the demi-god. Someplace between Clapton and Bloomfield he mastered discord distortion. His music was at once light and thrilling and villainous. He was magnificent. "All Along The Watchtower" stands as his most successful cut. His fast double-picking technique never sounded as dramatic. "Foxy Lady" was the seduction song. It hits you right in the groin. "Freedom" gradually became his theme – all swirl and aggression.

This 'live' set recorded at the Isle Of Wight festival captures a whole fist full of better moments. Not even the muddy production can blunt the effect of his riff control. Hendrix remains the most articulate guitarist yet to find breadth within rock'n'roll. Peter Green ex-Fleetwood Mac was his one major contemporary. Hendrix could sing the blues too. His broken rasp would plummet through the words and end up screamin' blue murder. It left you beside yourself. It *still* does. Jimi Hendrix remains a force to be reckoned with. His death must be one of rock's most lamented losses. – M.D.

"LIVING BY THE DAYS" – Elektra Stereo. EKS. 74101.

Every so often an album comes along – genuine killer stuff, guaranteed proof. Music-sound: the type that smoulders within the great American tradition.

It's to do with experience and maturity. It has a lot more to do with magic. Don Nix holds a great deal in common with Jaime Robbie Robertson. Both are masters of the self-same craft. Don Nix is ultra natural. His homespun images of rural spirituality seem to quiver beneath selfless conviction. They're sweet and hearty and earthen and melodic. His songs take you back to the Sabbath congregation – quite sober; yet willing to bend.

"I See The Light" and "Three Angels" seem to paraphrase the pride of the fields – all down home poignant. "The Shape I'm In" is just grand. It contains all the child-like reverence of country music rolled into one. Nix finds root in the suffering of the simple people. It's a refreshing change from the flash gadgetry of Jerry Reed Nashville. His songs are deeply religious.

Whereas the Band invites less hyperbolic discussion – Nix ain't about to complain. He's complex and emotional. Each track abounds with his wistful philosophy on the nature of tradition. "Olena" is the kind of lusty road song that you'd expect to find in the folk archives. Nix has progressed a little beyond the Band with regard to diversity and range. There's a big hunk of blues in what he does that refuses to be assimilated. "My Train's Done Come & Gone" could be The Butterfield outfit. It's certainly not to be overlooked. "Mary Louise" bowls along kind of sly and cunning Don Nix knows how to cook. His talent is uncontrived. What more can I say! "Living By The Days" was recorded with assistance. Chris Stainton, Roger Hawkins, Claudia Linnear, Joey Cooper, Don Preston and The Mt. Zion Singers were just a few of the super-session folk who gained credit. Recorded at Muscle Shoals and Memphis, this album runs amuck with quality. Production is fine – a place for everything; everything has its place. In fact, I'm gonna stop here and play the whole thing all over again! There's shimmering strings, honky piano, flat picking, dobro playing. slide and steel dubs – so much to listen to and enjoy. – M.D.

"FUTURE GAMES" Reprise Stereo. RS6465.

Fleetwood Mac occupy a rather elitist position within the rank order of British rock'n'roll. They provide an inner balance – a complementary contrast to the work proffered by such outfits as Pink Floyd, Soft Machine and King Crim son. Their approach is considerate and sparing. They possess a certain edge – an indefinable quality of performance, depth and insight that justifies most everything. Fleetwood Mac produce a remarkably evocative sound – juxtaposing images, rhythms and various textures with a blend of subtlety and precision. They're one of the last 'prestige' bands capable of reactivating the 12-bar format. "Sands Of Time", "Future Games" and "Morning Rain" focus their elusive character with splendidly shifting presentations marked far above the effect of the actual melody.

Fleetwood Mac centre each song on the strength and simplicity of the bedrock rhythm. Motion and tone are the all-important factors. Their music is insidious – genuinely magnetic. Impact is gained from the fluidity and sheer dogged insistence of the mood portrayed. "Sometimes" makes it via the curious country and blues guitar duet whilst "Show Me A Smile" finds the group well within acoustic framework.

Fleetwood Mac play predominantly mid-tempo blues with a gentility and poise seldom bettered. You've really got to hand it to them. This band has the warmth and perception to realize and extend their ideals. They maintain a musical generosity and sense of balance that rarely fails them.

"What A Shame" suffers more from over-enthusiasm than the expected flaw in structure. This is the general case with most of their faults. It's been over 12 months since Fleetwood Mac released anything of note. The wait has been well worthwhile. The absence of guitarists Peter Green and Jeremy Spencer is hardly noticeable. Christine McVie, late of Chicken Shack, and Bob Welch have proved themselves suitable additions. Production is quite outstanding. "Future Games" enjoys a consistency and clarity that one could boast about. Buy this album. – M.D.

'Three albums released over the last 12 months unbought by anyone' – "Down Home" by Seals & Crofts; "Later That Same Year" by Matthews Southern Comfort and "Space Oddity" by David Bowie. Each is yer veritable rock'n'roll masterpiece. People who've got 'em are usually more beautiful than people who 'aven't. – M.D.

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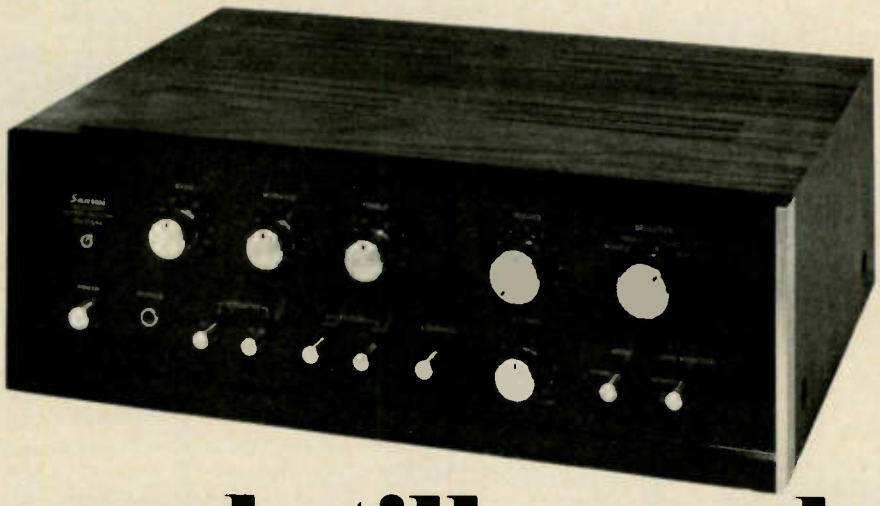

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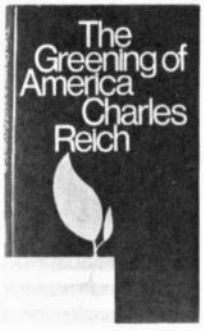


PLAN FOR A NEW SOCIETY

THE GREENING OF AMERICA, by Charles A. Reich, published by Allen Lane, The Penguin Press, London, and Random House Inc. New York. Hardback, 294 pages, $7.50. Our copy was supplied by the publishers.

The Greening of America is an optimistic book about American society.

The author sees the youth revolution as the forerunner of a complete change of society. The youth of today, he says, are a new type of people with different values, emotions, philosophy – a different consciousness. (Reich uses the term consciousness throughout the book to mean the way of life and thought of a person or a society.)

Reich describes the history of American society through several eras of consciousness.

Consciousness I is the traditional outlook of the American farmer, small businessman and worker who is trying to get ahead. Consciousness II represents the values of an organizational society. Consciousness III is the new generation.

American society at present contains examples of each type of Consciousness but Consciousness II predominates. Consciousness II people are tremendously concerned with one another's comparative status; they speak of others in terms of their abilities or lack of abilities. They believe that the individual should do his best to fit himself into a function that is needed by society – subordinating himself to the requirements of the occupation or institution that he has chosen.

Both Consciousness I and II see life as a fiercely competitive struggle for success, whereas Consciousness III postulates the absolute worth of every human being – every self.

Much of Reich's criticism of current society is aimed at the corporate status – the vast impersonal organisations of government and commerce that are dominated by technology – whose goal is progress regardless of human needs. Therefore, streams are polluted, forests are cut down, a pointless Asian war is maintained, all with no reference to the needs or the wishes of the people.

The corporate state, says Reich, is an immensely powerful machine, ordered, legalistic, rational, yet utterly out of human control, wholly and perfectly indifferent to any human values. In fact, the corporate state only has one value – the value of technology – organisation – efficiency – growth – progress. The man in the executive suite – the place from which power hungry men seem to rule our society, does not run the machine – he *tends* it.

Reich is far from an anti-technologist – nor does he advocate a return to nature. He points out the extent to which technology is used by today's youth. Light motorbikes for camping and trail riding electronic equipment for music and light shows, pills for safe sex.

Consciousness III, in fact, is the product of two interacting forces: the promise of life that is made to young Americans by society is affluence technology, liberation and ideals; and the threat to that

BOOKS cont.

TRANSISTOR AUDIO AMPLIFIERS by P. Tharma. Published 1971 by Iliffe Books, London. Hard covers, 413 pages 8½ x 5½. Australian selling price $19.00. Review copy supplied by Modern Books & Plans.

This book presents the various aspects of the design of audio amplifier and is based on the work done by the audio application group of the Mullard Central Application Laboratory.

The first two chapters deal with transistor characteristics. Chapters 3 to 10 consider the various aspects of circuit design and measurements. In chapters 11 to 16 various applications are considered and circuits given to illustrate the design principles.

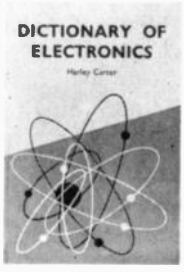
All necessary mathematical formulae and graphical diagrams are included at a level that is adequate for the majority of engineering design purposes. Although the mathematical treatment may be beyond the hobbyist, the remainder of the text is very practical.

The text is profusely illustrated with 245 diagrams including many circuits designed by Mullard for general use. All component values are given and each circuit is discussed fully. The advantages and disadvantages of various circuit arrangements are discussed in a manner which give the reader insight into the reasons for using particular configurations.

Many ancillary factors are discussed which results in a well rounded treatment of the subject. Such topics as distortion, amplifiers for high fidelity, public address systems and radiograms together with circuits for tape recorders hearing aids and power supplies are also included.

The final chapter briefly discusses the integrated circuit audio amplifier chips now coming onto the market in greater profusion.

In all a good book for the technician or engineer but too advanced for the beginner. B.C.



DICTIONARY OF ELECTRONICS By Harley Carter. Reprinted 1967 by George Newnes Ltd., London. Hard covers, 410 pages 7" x 5". Australian Price $5.95. Review copy supplied by Modern Books and Plans.

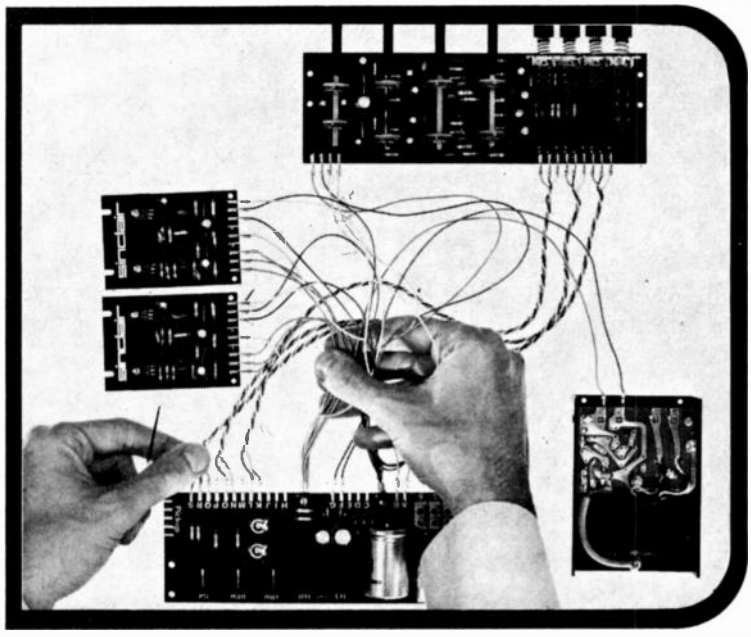
Over the last two decades the field of electronics has expanded at such an explosive rate that even those who are very proficient in a particular area may be totally unaware of significant details of other areas. Hence the relevance of a dictionary of electronics.

The fulfillment of this need however is attended by certain difficulties. Foremost amongst these must be the problem of keeping such a publication up to date.

This present dictionary has overcome this problem to some degree by reprinting every two years with an expanded addenda section. But even with this we find that in some areas there is no, or at least insufficient coverage. For example nowhere can any reference be found to the various types of integrated logic, although there are references to AND/OR, NAND/NOR gates. This sort of deficiency however is really inevitable, due, as was said before, to the rapid expansion of the field.

Apart from the above criticism the dictionary does provide an excellent reference facility. Whilst the average reference is dealt with in about 30 or 40 words, wherever there is a need the explanation may run to a full page or more. Graphs, drawings and circuit diagrams are all included where necessary to further clarify the written description. The text itself has been carefully written to convey all the necessary facts in the briefest possible way without sacrifice of clarity. Good value. – B.C.

The do it yourself amplifier for non-technical people who hate soldering irons.



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TALKING JAZZ

(Continued from page 109)

friends in the audience, you might get out of your night for $40!!

This is why I think Sydney people are so fortunate in having the Wentworth Hotel employ the Don Burrows Quartet. Sy Oliver is working in a club called the 'RiverBoat' in the Empire State Building and that room, holding 500 people, has become a very successful place. You can go down there for something like $11 per person and get a very nice 1 lb. sirloin steak dinner and all the works inclusive of all the drinks you want – no limit – so the $11 covers everything but your tip. If you come after 10 p.m. and only want supper, it is about $7.50.

T.G. – You mentioned touring with Daphne Helman.

J.L. – The tour with Daphne was another thing. I have always flown cross-country, and thus it was the first time since I came to New York from Boston at age 22, that I have toured by car; and at that time I was working with Muggsy Spanier and also did a little travelling with the Casa Loma Band.

The first half of our programme was sort of little Baroque arrangments of Bach and Scarlatti and many of the very old composers. These arrangments were actually taken out of the old scores and interwoven between the different instruments. Then Daphne did a little bit by herself and talked about the harp. Then we all came back for the second half and did a Beatles medley and some contemporary things.

T.G. – I was in a studio in Wellington with New Zealand jazz authorities Ray Harris and Keith Edmondston, when we heard of this year's disastrous Newport Jazz Festival.

J.L. – The 1971 Newport Jazz Festival had an audience problem and George Wein paid off all the players but I guess he lost about $100,000. These same musicians held a benefit for George before Christmas at the War Memorial Auditorium in Boston. The players appeared to this auditorium, which holds about 5,000 – for expenses – and believe me I have never heard of anything like that in the States!

I also did the 'Tribute to Louis Armstrong' night at Newport a year ago last July; a Swiss movie company filmed that concert.

They had about 16 trumpet players; there was Dizzy, Bobby Hackett, Wild Bill Davidson, Joe Newman, Jimmy Owens, you name them, all down the line. The Preservation Hall Jazz Band and Mahalia Jackson also performed that night and Louis, although he did not play, sang.

T.G. – Have you been involved in audience discussion concert tours of the type that Ray Price and Don Burrows perform throughout Australia?

J.L. – I have done this type of concert at a lot of the American universities when I was part of the 'Newport Jazz Festival All Stars' group which included Ruby Braff, Bud Freeman or Buddy Tate, George Wein, and either Don Lamond or Morrie Feld. We would go out for maybe a month and play six nights a week. There is a great market for this type of combined jazz concert and discussion group format in the States, and, the Universities have now actually got enough money to buy some of the best talent around.

We also did a whole circuit of schools where we played for kids from 1st to 12th grade. We would just come on and do our thing as a straight concert, and then have them ask questions about how we played; about our instruments; about how we knew what the next guy was going to do; why we played; what is improvisation; or how we played without reading music.

These are the ordinary questions that kids – or I guess even adults – would think of – if you have tours of this type in Australia I sure would like to be part of them. ●

INPUT GATE

LETTERS FROM OUR READERS

DAMPING FACTOR

Congratulations on throwing light on this latest in the numbers game. Your article is exactly what McIntosh contend. They say that it is not difficult to build an amplifier with zero internal impedance, but what does it achieve?

— John Brown, Leroya Pty. Ltd., Perth, W.A.

MORE DAMPING FACTOR

I enjoy reading Electronics Today and consider it the best magazine of its type in Australia. But I must protest, though, the very poor article by Mr Challis on loudspeaker and amplifier damping factors.

The first point I would like to take up concerns the difference between the manufacturer's quoted "nominal" damping factor and the actual damping factor at bass frequencies where it matters. Mr Challis says that it is in the piston range of a loudspeaker that damping has most effect, but fails to point out that many manufacturers quote a damping figure at 1000 Hz. As many amplifiers on the market today are coupled to speakers via a 2000 μF capacitor the damping factor at, say, 30 Hz will bear little relationship to the amplifier's "nominal" figure. Clearly, an amplifier specification that quotes damping factors at frequencies down to 20 Hz is going to perform differently from an amplifier with a "nominal" damping factor measured at 1 kHz.

Mr Challis goes on to discuss whether it makes any difference anyway. As I read the article he concludes that amplifiers with a "nominal damping factor" of 10 – 30 are adequate for hi-fi purposes. How can he reach this conclusion when he notes a slight "boominess" on loudspeakers when changing amplifier output impedance from 0.01 ohm to 4.0 ohms? Surely if we are talking about hi-fi rather than medium fi then a slight "boominess" is undesirable. If it can be detected and removed then that is an improvement worth having. When driving good quality bass reflex enclosures it is just this lack of "boominess" that I have come to associate with good damping or, rather, low output impedance in the bass frequencies.

I have run the same speakers from the same amplifier under three different conditions: (1) with a 2000 μF coupling capacitor, (2) with a 4000 μF coupling capacitor, (3) with no coupling capacitor (returning the speakers' negative terminal to a dummy centre rail formed by two capacitors between the H.T. rails.) The improvement is noticeable between conditions (1) and (2) and a further improvement occurs in condition (3). The improvement in clarity and in one's ability to pick subtle intonations in a bass line are slight on an A-B test but become very apparent on extended listening.

Mr Challis finds that fully enclosed speakers such as the AR6 and DM1 are less susceptible to changes in amplifier output impedance. I would agree that this is the case but maintain that the improvement gained by having a low output impedance is noticeable and worthwhile. Perhaps I should remind Mr Challis of his findings when reviewing the Advent (another closed box system) where he noted an improvement when connecting the speakers to an amplifier with a good damping factor.

— Michael Eres, Paddington, NSW.

* Louis Challis replies . . . .

The Editor said that he thought this would be a controversial subject – he was right!

In his letter Mr. Eres points out that many amplifiers have capacitively coupled output circuits – if, for example, a 2000uF capacitor is in series with the output, then this will add a further 2.65 ohms reactance at 30Hz. Our correspondent is quite right when he states that the damping factor at 30 Hz will be much higher than that at 1000 Hz, but our point was that this does not really matter, providing that the damping factor falls within the constraints outlined in the article (basically those of DIN 45,500).

Mr. Eres then discusses the effect of a 4 ohm output impedance but this is surely irrelevent for this corresponds to a nominal damping factor of only 2 and this, as we pointed out at the start of the article, is below the minimum damping proposed by DIN 45,500 and most certainly unacceptable.

Returning the speakers' negative terminal to a dummy centre rail formed by two capacitors between the HT rails does not eliminate the coupling capacitor – sketch it out and it is obvious.

The comment concerning the Advent speaker review is well placed and we retested the Advent speaker system with the original amplifiers used. What should have been said was that, when connected to a *better* amplifier (which fortuitously also had a better damping factor) there was a noticeable improvement in performance. Subsequent tests have confirmed that we mistakenly attributed the subjectively detectable difference to the damping factor instead of the amplifiers themselves.

Our correspondents have highlighted the fact that not only is the effect of damping factor, or output impedance, little understood, but also that its effect can be modified at low frequencies by the capacitive reactance of coupling capacitors, by the phase change in the output circuitry, and last but not least, by the type or quality of the speakers used subjectively to appraise the quality of an amplifier.

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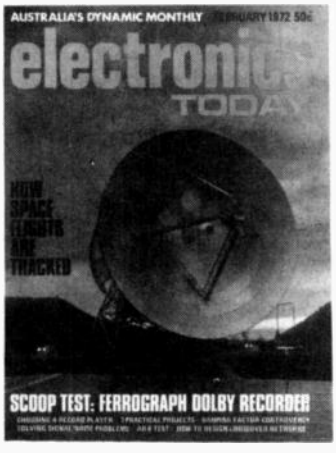

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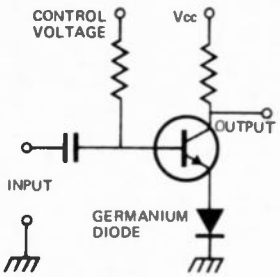
ADVERTISERS' INDEX

TECH-TIPS

GAIN CONTROLLED AMPLIFIER

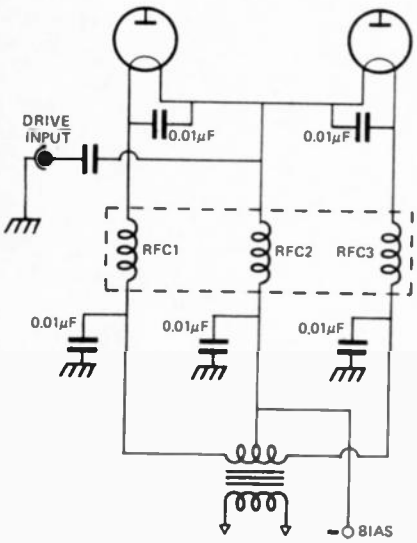


In this circuit a germanium diode is used to effect gain control of a common-emitter amplifier.

This circuit is very useful for AGC controlled stages, or where wide dynamic range and instant response is required.

The diode selected for this application should have wide impedance variation and a relatively gradual rate of change. Types IN 34A, AAY 30 etc. are suitable.

FILAMENT CONNECTIONS



High power linear amplifiers using twin valves in the grounded grid configuration are quite commonly used.

But problems can occur if series filament connections are used, for the filament of one tube will often warm up quicker than that of the other. This prevents the second tube warming up, as the first tends to 'hog' the available current.

The circuit shown above overcomes the problem by using a centre-tapped transformer. (two back-to-back diodes across the filament lines will do the same job)

The filament chokes consist of about 50 turns of wire trifilar wound on a ferrite rod, 6" long.

ERRATA

Despite the most careful copy checking, drawing and printing errors creep in from time to time.

In future any known errors will be published under the heading 'Errata'. The page number of the Errata column will be included in our index on page 3 (under the sub-heading 'news and information'), where possible however the column will be included in the 'TECH-TIPS' section of the magazine.

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With the exception of the May 1971 and July 1971 issues, back copies of ELECTRONICS TODAY may be obtained for 80 cents each, including postage and packing.

If complete articles are not required, photostat copies of individual articles are available (including May and July 1971 issues) at 50 cents per article, plus 10 cents minimum postage.

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