FEBRUARY, 1973
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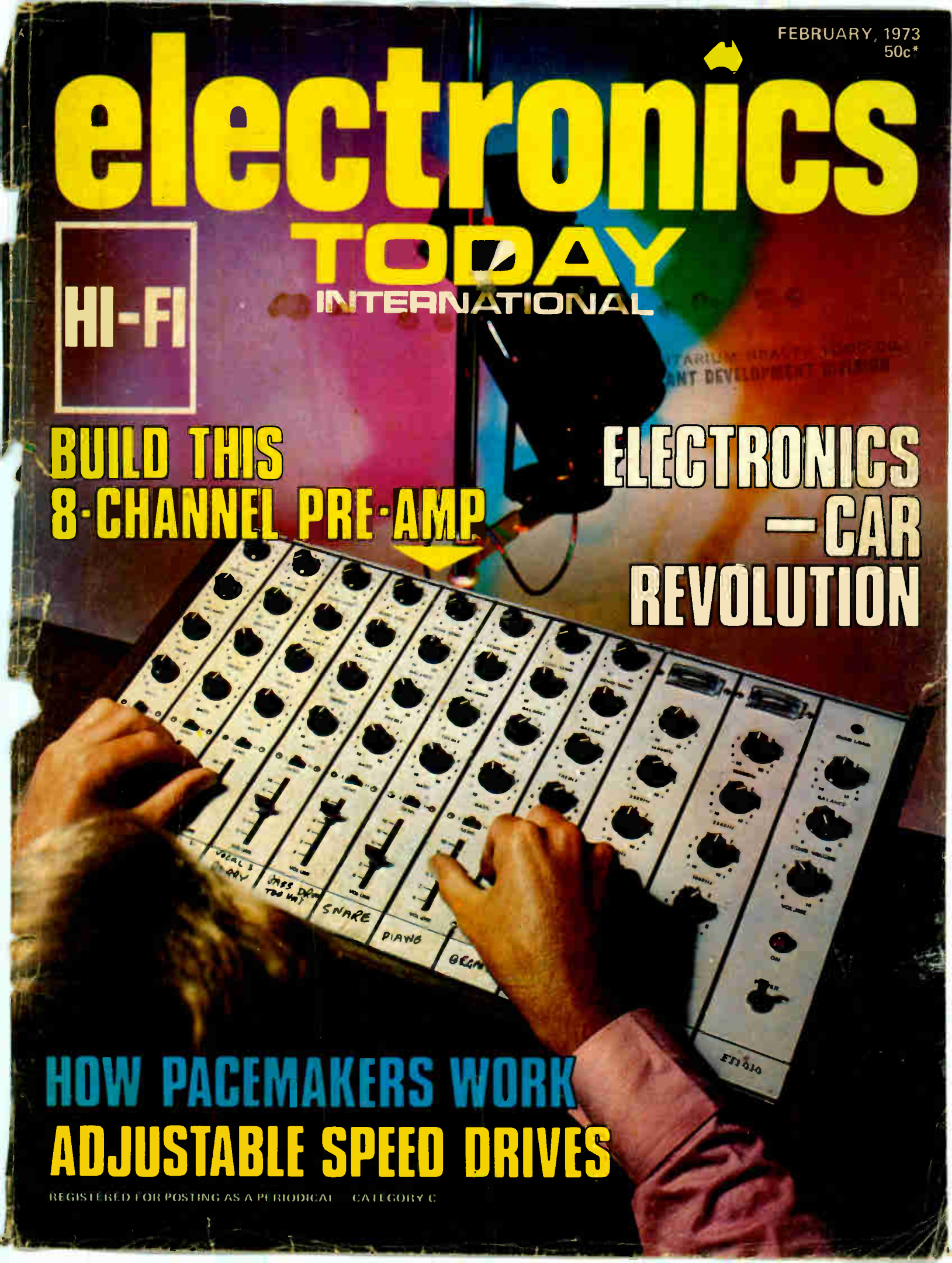

HOW PACEMAKERS WORK

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Finally, the hard-headed Dolby!

Sony presents the models you've been waiting for...

TC-134SD

TC-161SD

SONY announces two stereo cassette tape decks that get the best out of Dolby* wih new Ferrite & Ferrite Heads. What's Dolby? Dolby is a noise reduction system. Low-level high frequencies are boosted before recording and then attenuated during playback. S/N ratio is significantly improved; recorder noise and hiss are virtually eliminated.

But Dolby only gives impressive results if the tape deck is impressive to begin with.

SONY's new Ferrite & Ferrite Head assures the excellent tape-to-head contact that Dolby recordings require. Perfect for Cr02 tapes, Ferrite & Ferrite Heads last 200 times longer than ordinary ones.

Other TC-134SD desirables include automatic total shut-off, peak limiter with defeat, normal/Cr02 tape selector. In addition the TC-161SD features closed-loop dual capstan tape drive, hysteresis synchronous motor and a memory tape counter which automatically stops at any preset "000" when rewinding.

Hear SONY's hard-headed Dolby decks soon.

JACOBY KEMPTHORNE

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SONY®

The people who invented the transistor, then went to the moon.

*Dolby is a trademark of Dolby Laboratories Inc.

SN1957

For further information please fill in the Reader Service coupon in this issue.

electronics TODAY INTERNATIONAL

February 1973 Vol. 2 No. 11

main features

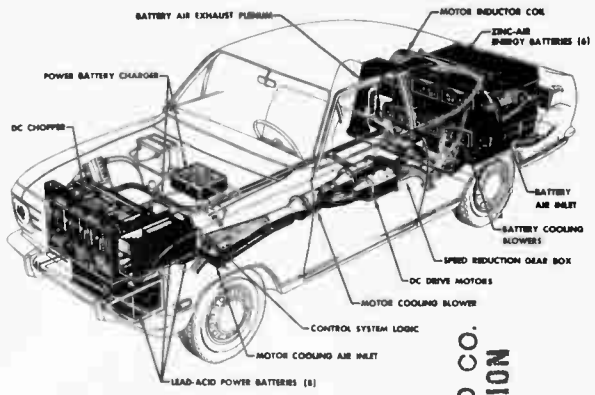
projects

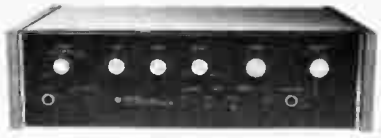
product tests

reviews

news & information

COVER: This versatile multi-input mixer/amplifier has all facilities required for professional public address system use. (Full constructional details start on page 50 of this issue).





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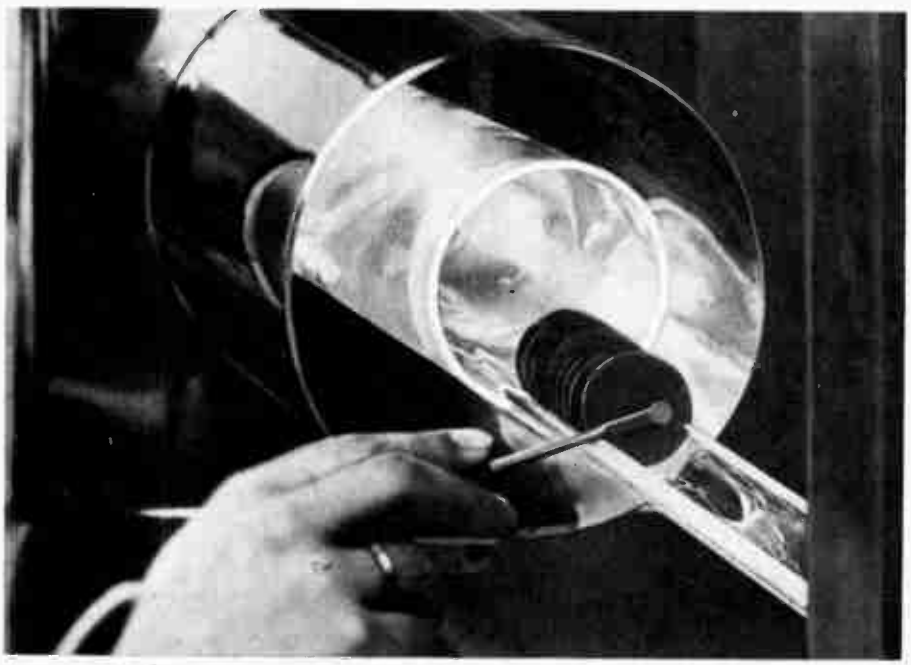
by Philips of course



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Space flight, computers, advanced instrumentation systems, pocket calculators and the ubiquitous transistor radio are all taken for granted by engineers and scientists as well as by the man in the street. Yet it is only 25 years since Doctors Shockley, Brattain and Bardeen, (at that time with Bell Labs), made the momentous discovery which produced all these and many other technological marvels.

The discovery of the transistor, rivalled only perhaps by nuclear fission in its impact on mankind, earned for its co-inventors the Nobel Prize for physics in 1956. At first the transistor received little acclaim, but never in the history of mankind has one discovery led to such far-reaching technological developments.

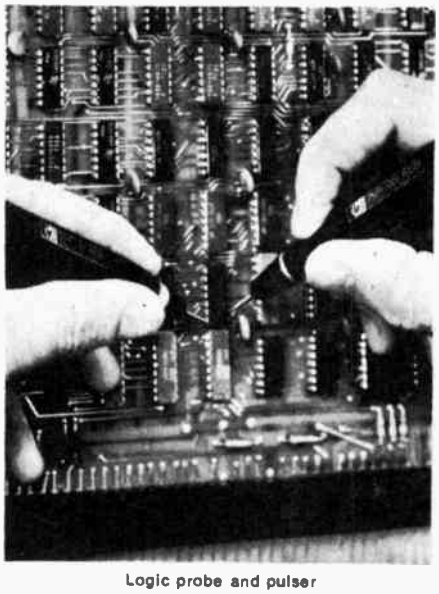
The mammoth companies of Texas, Motorola and Fairchild owe their entire market empires to products based on the first crude device fashioned by Shockley and his co-workers.

In the future it is to be hoped that solid-state electronics will be applied to the betterment of the world's environment, rather than to instruments of war, and thus help create a utopian future for our descendants.

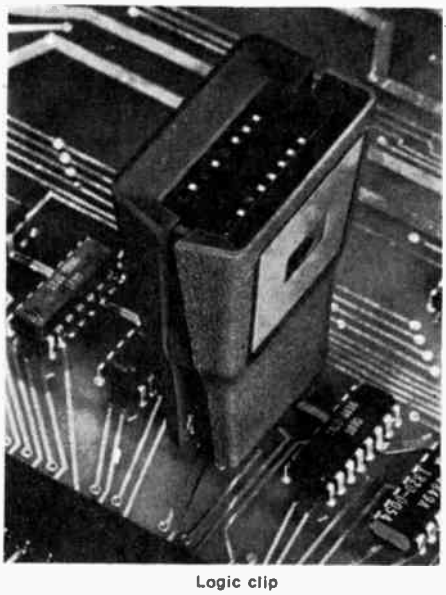
Electronics Today International joins with the entire electronics industry in paying homage to Shockley, Brattain and Bardeen in 1973, the 25th anniversary year of their discovery. ●

Brian Chapman

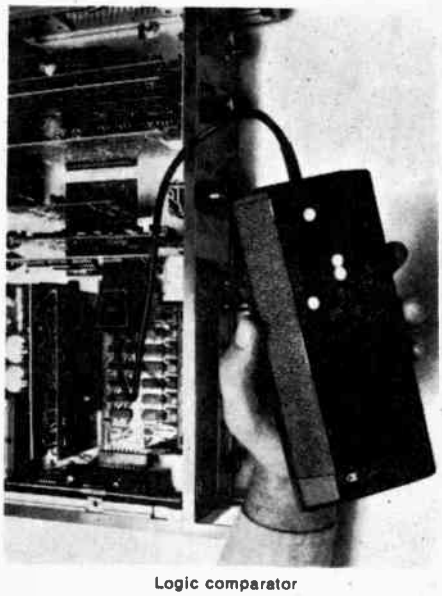
THE WORLD'S LEADING
IC Troubleshooters



Logic probe and pulser



Logic clip



Logic comparator

Model 10525T Logic Probe
- Dynamic indicator of logic activity
- Pulse stretching for pulses down to 10 ns
- Bad level detection
- No adjustments required
- Indicator at finger tips
- TTL/DTL compatible
- Safe overload protection

10526T Logic Pulser
- In-circuit stimulation without unsoldering
- Automatic injection of proper polarity pulse
- Greatly simplifies digital troubleshooting
- Output protected against overload
- TTL/DTL compatible
- Enhances utility of Logic Probe and Clip

Model 10528A Logic Clip
- Displays IC logic states at a glance
- Self-powered, self-contained
- No adjustments required
- Compatible with TTL/DTL logic levels

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

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Select Sansui stereo amplifiers for...

Superior design
Superb engineering
Sparkling performance


AU-505

When you're considering the purchase of a complete new stereo system, the control amplifier is the key to the whole program. So it's worthy of detailed analysis.

There are six audibly superior control amplifiers in the Sansui range . . . from 30 watts RMS to 100 watts RMS. All feature *all-silicon* transistor design — and distortion is considerably *less* with Sansui control amplifiers, as output stages are semi-complementary Darlington designs without *input* or *output* transformers. Transformers have always caused some distortion problems in amplifier design — but not with Sansui!

The startling difference you will notice with any Sansui stereo amplifier is the *tonal quality* and the obvious *dynamic range*. In every price bracket your new Sansui amplifier sounds like a much more expensive unit. These are not idle words. In the review of the least expensive Sansui amplifier, the AU-101, a leading Australian journal said . . . "*. . . few amplifiers, regardless of price, give an overall test result as good as this*". Another review said . . . "*. . . better than most other amplifiers at twice the price*".

With those comments made about the AU-101 (recommended price $149) can you imagine how effective the other models in the Sansui range are? With more power and, let's face it, higher price tags?

Let's look at the complete Sansui stereo amplifier range:


AU-555A

MODEL	POWER RATING at 8 ohms.	FREQUENCY RESPONSE	REC. PRICE
AU-101	30 watts RMS	20-60,000 Hz. ± 2 dB.	$149
AU-505	50 watts RMS	20-60,000 Hz. ± 2 dB.	$199
AU-555A	50 watts RMS	20-40,000 Hz. ± 1 dB.	$237
AU-666	70 watts RMS	10-40,000 Hz. ± 1 dB.	$325
AU-888	90 watts RMS	10-70,000 Hz. ± 1 dB.	$403
AU-999	100 watts RMS	5-100,000 Hz. ± 1 dB.	$460

IMPORTANT: All prices are recommended prices only. The actual cost can well be less — as trade-in valuations can make a world of difference. See your Bleakley Gray franchised dealer!

Bleakley Gray Corporation Pty. Limited,
28 Elizabeth Street, Melbourne, 3000.
Please send me complete details about the Sansui amplifier Model .....
and the name of my nearest Bleakley Gray dealer.

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W.A. DISTRIBUTORS:
Atkins Carlyle Limited, 1-9 Milligan St., Perth, 6000. Tel. 22 0191.

Sansui equipment is manufactured by:— Sansui Electric Co. Ltd., 14-1, 2-chome, Izumi, Suginami-Ku, Tokyo, Japan.

BG—SA—1272

INSTROL

SLASHES A.D.C. PRICES

ADC STEREO CARTRIDGES — AMERICA'S QUALITY CARTRIDGE

ADC 220X .. $17.00

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

ADC 10E mk4 ... $51.00

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

ADC 220XE ... $22.00

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

ADC 550XE ... $30.00

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

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(B) SANSUI TA1050 ARM	A high precision universal arm. Oil damped cueing lift is fitted. Anti skate. Separate stylus pressure gauge.
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(D) INSTROL 44 STAND PLUS HINGED 'PERSPEX' COVER.	This acoustically sprung player stand is available in either oiled teak or walnut, complete with moulded perspex cover and "stay-up" hinges.

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T302

INSTROL SPEAKER SYSTEMS

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

MAGNAVOX 8-30 SYSTEM

at reduced prices.

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

COMPLETE SYSTEM

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

SEPARATE COMPONENTS

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

NEW E.T. MAGNAVOX 8-30 DESIGN

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

COMPLETE SYSTEM

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

SEPARATE COMPONENTS

Speakers and crossover only	$45.00 (one side only)

WHARFEDALE SPEAKER SYSTEM KITS

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

COMPLETE SYSTEM

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

SEPARATE COMPONENTS

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

INSTROL and SEAS COMBINE

to present 2 NEW speaker systems
the BROADWAY 201
and BROADWAY 251

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

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

COMPLETE SYSTEM

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

SEPARATE COMPONENTS

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

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Please send me the following speaker systems or turntable system. These will be sent by road transport or passenger rail, freight payable on receipt of goods. (Cartridges will be sent freight free).

. . . . . at $. . . . .

. . . . . at $. . . . .

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

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Sizzling!

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

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

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

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

Now examine closely these brief specifications:

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

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

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

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

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

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

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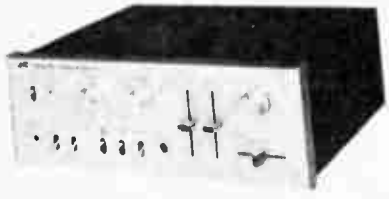

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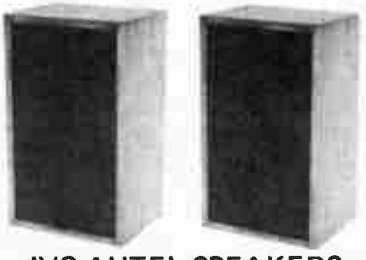
15 R.M.S. per channel
High/Low filter. All
facilities.

DUAL 1214 TURNTABLE
Manual or Auto.
Complete with
Shure 55E Cartridge.

SYSTEM COMPLETE FOR $339.00



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8" 2 way – 25 watts
R.M.S. 25 – 20 kHz

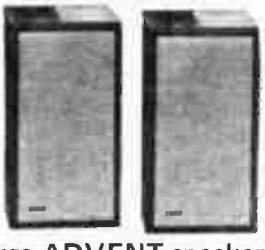
DUAL 1218, SHURE 91ED
Cartridge. Professional
quality making a
perfectly matched
system.

TEAC AG 7000
80 watts R.M.S.
per channel
AM/FM Tuner –
2 tape circuits.

SYSTEM COMPLETE FOR $1195.00

JBL – Exact copies of
the famous L55 speakers
using JBL 5 + 2 speakers –
unbelievable must
be heard.

MARANTZ 1060
Tested in excess of 40 watts/
channel before clipping. Base,
Treble, midrange control,
Hi-Filters plus all facilities.



Large **ADVENT** speakers.
Designed by the man who
made A.R. speakers famous
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DUAL 1216 TURNTABLE
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AUTEL SYSTEMS PTY LTD

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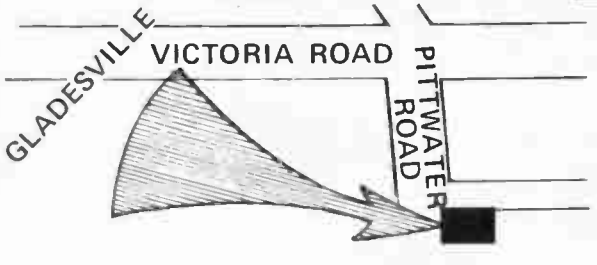

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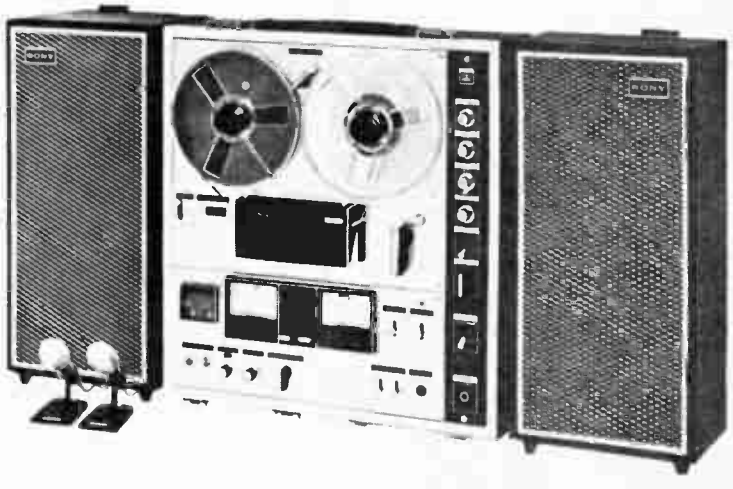

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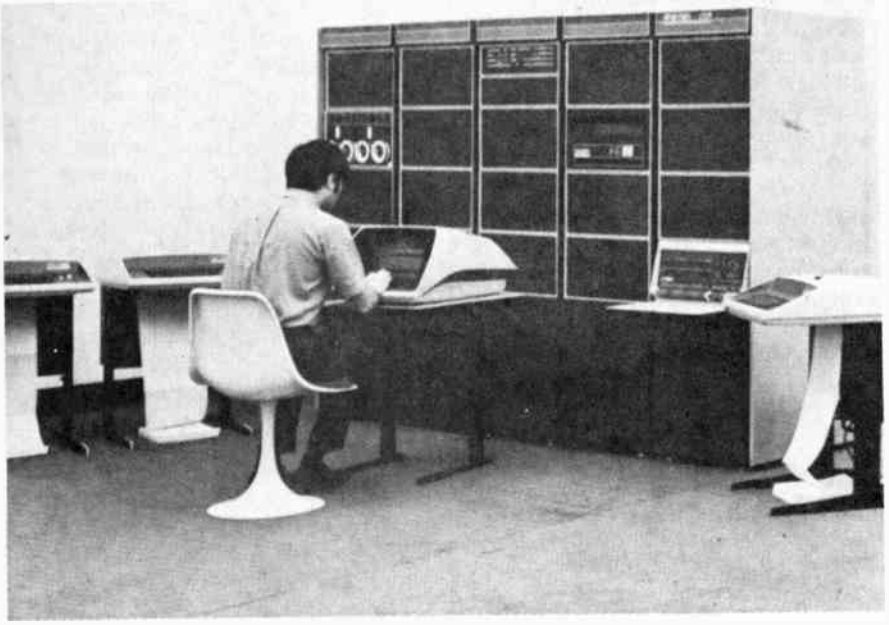
news digest

GLADSTONE POWER STATION CONTROL COMPUTER SYSTEM



A P.D.P. 11/45 Computer System, similar to those to be used for Control and Data Aquisition in the Gladstone Power Station.

The Gladstone Queensland Power Station will have a total generating capacity of 1,100 Megawatts, its four identical 275,000 kW turbo-alternators being driven by steam from four coal-fired boilers. The centralised control system will include data-logging equipment, automatic turbine starting facilities, and a fully automatic control system for the boiler plant.

The data acquisition and control system for this $200 million project will be supplied by Data Technology Pty. Ltd., a wholly Australian systems house. It will be locally integrated from system modules supplied by Digital Equipment Corporation, and Computer Products Inc. Data Technology will also undertake all systems design and software for the project.

The computer system and much of its input/output equipment will be duplicated, permitting normal system operation during maintenance or failure of a major systems component. The computers will be two P.D.P. 11/45's, with magnetic discs, tapes and video displays. Computer Products' process input/output equipment provides the means for the computers to access the 3,400 analog and 2,600 digital data sources which are to be monitored.

The system will calculate, log and report the plants' status and performance data, provide turbine start-up and shut-down control, and issue plant alarms to the operator.

DIGITAL CLOCK ON SINGLE CHIP

A complete digital clock on a single chip has been developed by the National Semiconductor Corporation. Called the MM5314 series, the digital clock circuits contain all of the counting, decoding and multiplexing circuitry required for a four or six digit electronic clock.

The MM5314 series is made with National's P-channel enhancement mode low threshold process, and operates from a single 11 to 19 volt supply. It operates from a half wave rectified 50 or 60Hz input. This input signal is then shaped and divided by either 50 or 60. Three other counter stages complete the division to 12 or 24 hours.

The built-in multiplexer samples the outputs from these counters and routes them to an on-chip ROM which is programmed to provide both BCD and seven-segment outputs. The display scanning rate is controlled by an external resistor and capacitor. The MM5314 is designed to work with inexpensive plastic transistors for digit and segment driving of standard LEDs or incandescent displays.

Fast slew, slow slew and hold control are provided to set the clock. The fast slew advances the hours counter at a one hour per second rate; similarly, the slow slew control advances the minutes counter at a one minute per second rate. The hold control stops the counter chain and thus the seconds digits can be set.

Australian distributors are NS Electronics, Stud Road, Bayswater, Vic. 3153.

NEW IRH INDUSTRIES CHAIRMAN

Mr. L. W. Port, B.E. has been appointed Chairman of IRH Industries Limited.

A graduate of Sydney University, Mr. Port is a consulting engineer and has been on the board of IRH Industries Limited for some years.

His appointment follows the death earlier this month of the company's previous Chairman, Mr. C. J. Stevens.

SONY FORMS SUBSIDIARY FOR VTRs

Sony Corp. has established a manufacturing subsidiary to produce video tape recorders and video cassette systems.

Called Sony Corp. of Kohda, it will be capitalized at 1 billion yen ($30 million). A plant is being built on 108,000 square metres in a new industrial complex near Nagoya, Aichi prefecture.

Sony is now making VIRs at its Shibaura and Atsugi factories and also at Teac Video Co., a joint venture. This production will continue, but a spokesman said increased demands for VIRs necessitated the new subsidiary.

ELCOMA EXPORTS

Over three million transistors have been ordered from the Elcoma Division of Philips Industries for delivery in Britain and the USA.

news digest

SPACE HOAX?

The authoritative British journal New Scientist in its issue of January 4 spoke of a letter that it received claiming that the whole US space program was a hoax.

"And why not," commented the New Scientist. "The US is already perpetrating some of the most massive hoaxes in history."

The article went on to point out that with at least as much TV time as given to the space program, the US were shown to be withdrawing troops from Vietnam. Yet, said the journal, the number of US troops in Vietnam did not change during 1972.

Apart from that, the biggest hoax of all, said the New Scientist, was aimed at convincing American voters that a peace treaty was about to be signed.

"Any Government that would hoax not only its own people but also a foreign government to win an election – said the journal – would not stop short at fabricating an entire space program."

BOMB SNIFFER

A team of chemists in California have devised a technique for detecting hidden quantities of TNT.

According to a report – in the November issue of Analytical Chemistry – the method used is negative ion mass spectrometry. When TNT is bombarded with energized electrons, the resulting spectrum of negatively charged fragments has an intense peak. Other nitro based explosives produce a similar signal but can be identifyed by changing the detector's electron energy.

The technique is claimed to be astonishingly sensitive and quantities as small as one trillionth of a gram can be detected. Apart from this the device is not affected by temperature changes nor by most air contaminents.

ENVIRONMENT '73

A comprehensive exhibition of equipment, techniques and services, including instrumentation for monitoring and measuring pollution of air and water, is being staged in Sydney from February 21-25, 1973.

Equipment from several overseas countries will be displayed and demonstrated together with a wide variety of Australian developed and manufactured products.

Exhibits include monitoring, measuring, dust and fume control, recycling, and solid waste treatment including compaction, pulverisation, recycling and incineration.

Particular emphasis will be placed on recycling operations, water and waste water treatment, prevention of oil pollution, air pollution in Australia, economics of environment impact, automatic air pollution monitoring systems, management of natural resources, sewerage, garbage handling and disposal, noise pollution, etc.

The United States of America is officially sponsoring a trade mission led by Mr. Frank Sebastian, Senior Vice-President of Envirotech Corporation. Several members of the mission will present papers at the Conference.

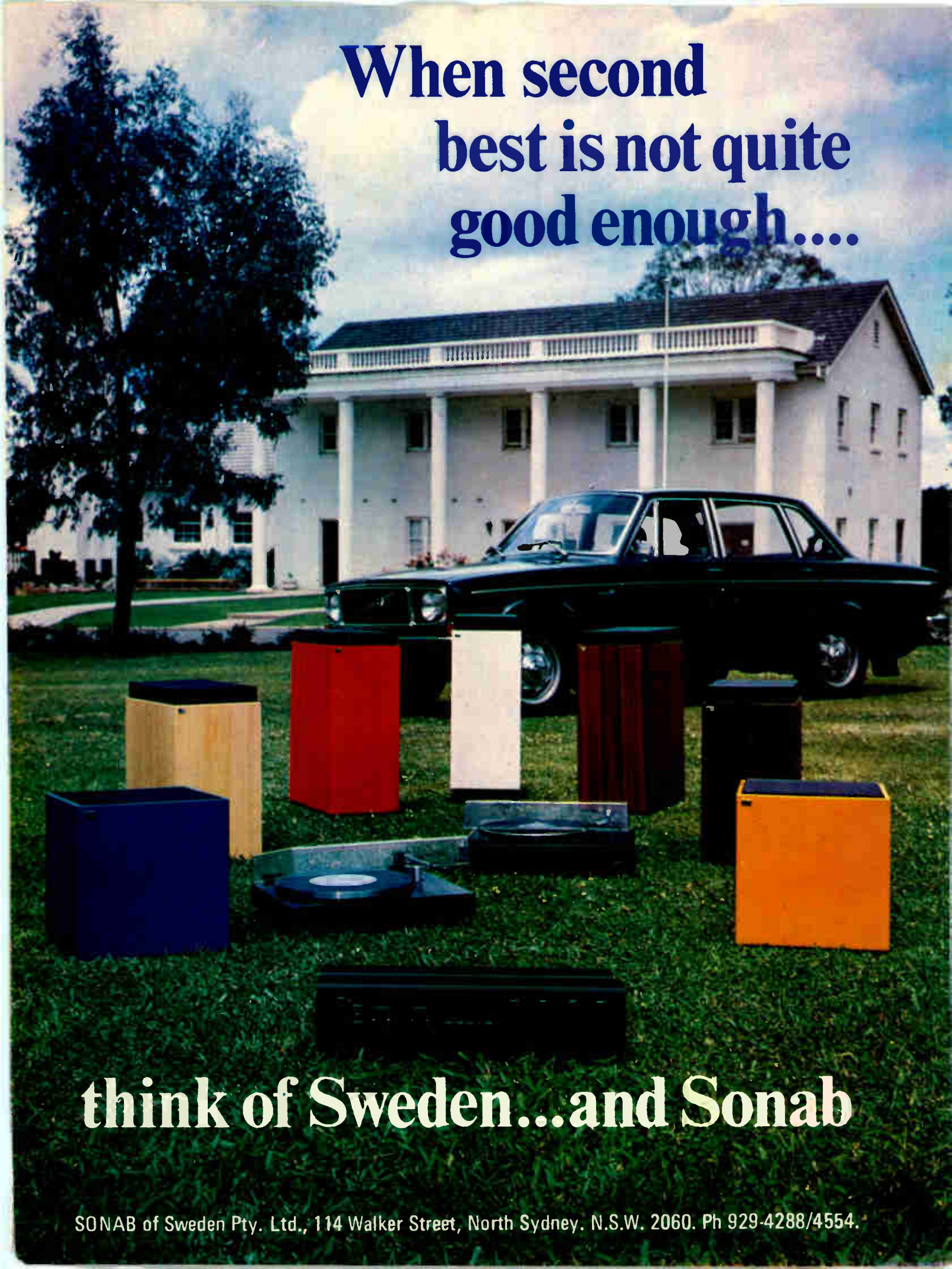
In addition to the main conference which will be of interest to State and Federal Government departments, engineers, architects, consultants, industrial and commercial executives, a special symposium dealing with management of natural resources will be staged on Friday, 23rd February. It will cater for groups outside of the directly technological sphere on environment and pollution prevention and control.

The Swedish Government is sending a large trade delegation led by Mr. Ingemund Bengtsson, Minister for Agriculture and Environment. Included in the delegation will be keynote speakers, Mr. Valfrid Paulsson, Director of the Swedish Environmental Board and Mr. Axel Ilveroth, Director-General of the Federation of Swedish Industries.

The organisers expect that this conference will be of very great interest to a large number of people. Because of this, attendance will be by pre-registration only. Intending delegates are asked to notify the organisers Total Concept Exhibitions, P.O. Box 127, Balgowlah, NSW, 2093 immediately.

The exhibition itself will be open to the public on Saturday 24th and Sunday 25th of February – and to the trade Wednesday 21st to Friday 23rd. Venue is the R.A.S. Showground in Sydney.

(Continued on page 125)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CARS— FUTURE SHOCK?

Vehicle of the future? Sundancer I has been built by US ESB Corporation to research desirable vehicle characteristics for electric propulsion. (Inset is solid-state voltage regulator from Britain's Joseph Lucas organisation).

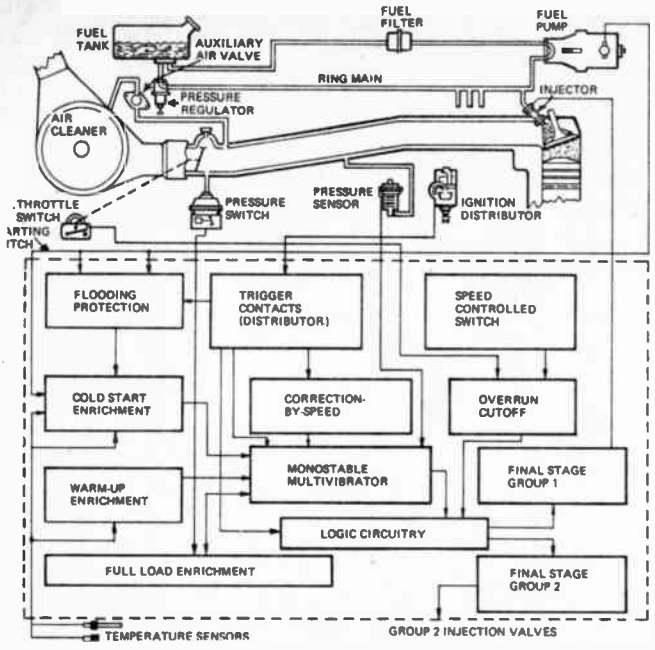


Fig. 1 Schematic drawing of fuel injector system.

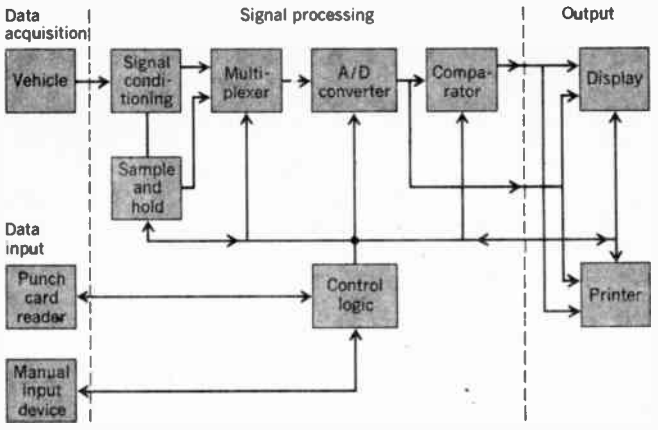


Fig. 2 Block schematic of VW's computer diagnostic system. In use, the vehicle is connected to the computer via 28-way cable.

Electronics may revolutionize the car as we know it today — ex GM research engineer and now Editorial Director of Electronics Today International — Collyn Rivers reports.

Since Shockley's invention of the junction transistor back in 1949, electronics engineers have confidently forecast the solid-state take-over of Detroit.

The latest estimate by Lester Hogan (President of Fairchild Camera and Instrument Corporation) is of a $5 000 000 000 market for vehicle electronics by 1980 in the USA alone.

This seems optimistic in the extreme, for assuming that the US car manufacturing market will level off to the generally predicted 10 million per year, Hogan's forecast implies that the cost of the electronics per car will be $500 at *manufacturing level alone*, hence the value of electronic assemblies in the finished vehicle would be at least $1500, nearly half the price of the car.

Nevertheless electronics is being used more and more by the motor industry — in many cases because electronics is the only practical solution to the anti-pollution and safety problems that the government has insisted the carmarkers resolve.

Dr. Villa, head of FIAT'S electronics division takes a more cautious view. In a paper delivered to the I.E.E.E. last year he forecast that (assuming the retention of petrol driven vehicles), electronics would account for some 10% of the cost of a car by 1980 and 12% by 1985.

He felt that the areas of expansion would include solid state transducers and actuators, and the development of digital devices using MOS technology in MSI and LSI custom made chips to aid in system integration.

Needless to say electronics are being used more and more in today's vehicles — and will continue to be so as solid-state devices are developed that can stand up to the surprisingly harsh environment in which they must operate.

Few electronic engineers realize just how harsh this environment can be. Underbonnet temperatures for example can vary from −45°C to +120°C — humidity from zero to 100% — in fact devices must continue to work even if covered in oil or water.

Apart from the wide range of ambient temperature, the nominal 12 Vdc supply is very far from being that. Transients approaching 400 volts are quite common; just disconnecting the battery may produce a negative spike from the alternator of at least 70 volts. Many garages will 'boost start' a cold vehicle using a 24 volt battery, so here again steady voltages of at least 28V may be experienced.

As if this were not enough, vibration and shock loadings can be unexpectedly high. Even a simple action such as slamming a car door can transmit acceleration levels of well over a hundred G to the dashboard.

Small wonder then that so many ill conceived CDI ignition systems ceased to operate after a short time!

Fortunately the recently developed complementary MOS (CMOS) can tolerate harsher working conditions than previous integrated circuitry and has the additional advantage that it can more readily be interfaced with 12 volt operated devices.

CURRENT DEVELOPMENTS

At present, research and development is concentrated on several areas. The first is to see what existing mechanical or electro-mechanical assemblies can usefully be replaced by solid-state equivalents. And by 'usefully' what the motor industry means is more cheaply, for the existing systems have been proved more or less adequate for many years. Incremental cost is very much the name of the game.

In this category are electronic ignition and fuel injection systems, solid-state voltage regulators, air conditioner controls, warning systems, instrumentation etc.

ELECTRONIC IGNITION

Although one would never believe this from the advertisements, the conventional (Kettering) ignition system provides adequate performance for the average (non-racing) car. And providing the system is maintained in good order, little (if any) increase in performance will be attained by fitting an electronic system.

But the key word is 'maintained', and in practice very few cars have ignition systems in good working order. The big advantage of the electronic systems is that once installed, the ignition system will from then on require very little routine maintenance.

Whilst the more ambitious electronic systems seek to replace most components of the existing ignition system, (as in CDI systems), many companies are content to devise ways of eliminating the contact breaker points alone.

Chrysler (USA) has now switched

CARS– FUTURE SHOCK?

totally to a semi-electronic ignition system for their full range of petrol driven vehicles. The company have devised an outwardly normal-looking distributor, but one in which the contact breaker points have been replaced by a rotating magnet and a reluctance transducer – basically a coil of wire in which a pulse is induced by the rotating magnet.

The magnetically generated voltage pulse is amplified by a power transistor which switches the primary circuit of the ignition coil.

A similar system has been available from General Motors for some years – but only as an optional extra.

Critics of the system say that it does not put out uniform pulses over the full range of engine speeds, and that as the output from the reluctance transducer is related to velocity, engine starting is very difficult at low cranking speeds. In practice however, the system seems to work very well.

Mallory use a breakerless system in which the contact breaker points are replaced by a small globe and photocell. A shutter wheel rotating between the two, exposes the photocell to the light from the lamp at the precise points where ignition pulses are equired.

Also available – but not so far as original equipment – is the capacitor discharge ignition system (generally abbreviated to 'CDI'). All CDI systems work in a basically similar way. In effect they use a dc-to-dc converter to raise the level of the 12 Vdc supply to approximately 400V. The output of the converter then charges a (typically) 1.5 uF capacitor which is discharged through a switching element – such as an SCR – into the primary winding of a specially wound ignition coil.

A recently developed CDI unit – the Delta Mk Ten 'B' controls the spark duration as well as intensity – an effect that the maker claims reduces exhaust pollution.

Although electronic ignition systems got off to a shaky start – due primarily to the electronics industry's failure to allow for the harsh working environment – it seems practically inevitable that the electronic ignition system will shortly replace the electromechanical system – if only because the reduced need for maintenance lessens the probability of pollution from badly tuned engines.

ELECTRONIC FUEL INJECTION

As with electronic ignition systems, electronic fuel injection plays a valuable role in reducing pollution. In the latter case it does it directly: accurately metering the air-fuel requirements of the engine.

A number of electronic fuel injection systems are already used as standard equipment. A typical unit is shown in Fig. 1. This unit, developed jointly by Bosch and VW contains some 250 components including 30 transistors and nearly 40 diodes.

Fuel is pumped from the tank into a ring main for distribution to all injection valves. A pressure regulator maintains a constant 28 psi in the ring main.

Electromagnetic injector valves in the inlet manifold are opened and held open by a pulse from the control unit. The pulse width, is governed primarily by engine speed and load conditions, it varies from two to 10 milliseconds.

The ignition distributor has the usual breaker points etc, but in addition two non-adjustable trigger contacts 180° apart are located in the lower part of the distributor housing.

Signals from these contacts are used in the electronic control unit to trigger a speed controlled switch, flooding-protection circuitry and a monostable vibrator circuit.

Load information is provided by a pressure sensor in the intake manifold. Information is also obtained from sensors monitoring cold-start conditions, warm-up, enrichment, etc.

In Britain, Joseph Lucas have developed a fuel injection system based on an MOS digital memory. In this system the main parameters monitored are throttle angle and engine speed and digital signals derived from these and other parameters determine engine fuel requirements.

The digital memory used in the Lucas system has a storage capacity of 256 x 7 bits words – i.e. 1792 bits altogether.

When tested on a Triumph sedan, the emission measurements were just short of that required to meet the USA's fairly stringent 1975 Federal and Californian legislation requirements.

As with electronic ignition systems it seems reasonably certain that electronic fuel injection will take over from conventional carburetors. In fact in a report to the Environmental Protection Agency, the USA's National Academy of Sciences said that in their opinion, electronic fuel injection would enable the automobile industry to meet current anti-pollution legislation – in particular the difficult-to-meet section that requires the vehicle engines to maintain emission levels below the legal limits for at least 50 000 miles without adjustment.

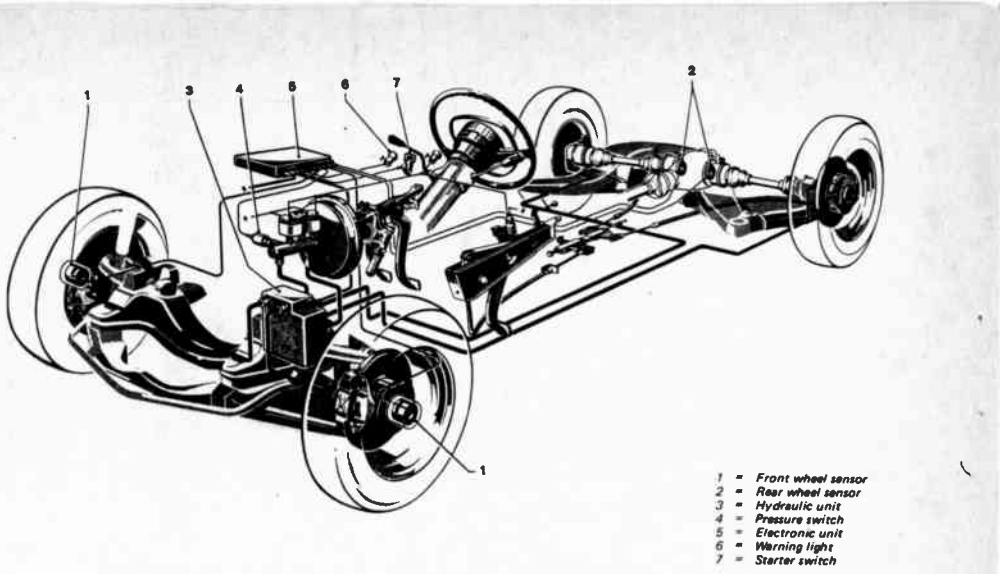


Fig. 3 Mercedes anti-lock braking system. Digital transducers (1,2) send signal proportional to wheel velocity to central control unit. If signal indicates wheel deceleration is above 1.3G, electro-magnetic valve reduces pressure in hydraulic brake line to wheel/s concerned.

ELECTRONIC SERVICE CENTRES

A second area in which the automobile and electronic industries have formed an alliance is in developing computerized testing facilities.

This is an area that scares both industries half out of their collective minds, for the automobile people are only too well aware of just how bad servicing can be – and will even admit this privately. The electronics people quake at the thought of the average semi-skilled garage mechanic attempting to sort out the entrails of a fuel injection computer.

Here, Volkswagen appear to have beaten their competitors with a computerized self-analysis system.

Designed (in conjunction with VW) by Siemens in Germany the diagnostic unit checks out over 60 separate items in less than thirty minutes.

The diagnostic unit is plugged into the vehicle via a multi-way connector (built into all VWs from 1972 onwards). A program card, applicable

to each model and year, is inserted into the diagnostic unit's program card reader. Then, using a hand-held input unit, a technician follows a predetermined test sequence. Most tests are made automatically, but occasional tests must be made manually (tyre pressures for example). At the end of the sequence the complete test results are printed out on a diagnosis form.

Figure 2 shows a block schematic drawing of the diagnostic unit. As may be seen, the unit is basically a data logging system in which input data are translated into a form compatible with the system. The data is then digitized and compared in sequence with the manufacturer's specifications. If any measured parameter is found to be outside the correct limits a note to this effect is printed out on the results card.

Some of the tests performed include:—

a) Cylinder compression — (this is checked by monitoring the voltage drop across the battery earthing strap whilst the starter is turning over the engine (the ignition system is meanwhile temporarily disabled). The ac component of the drop is related to engine compression and it is this component that is monitored.

b) Ignition timing — a metal projection on the engine flywheel indicates top dead centre position. This projection is sensed by a reluctance transducer, and related against a signal derived from the spark plug firing times, provides data enabling the diagnostic computer to evaluate the timing.

Battery condition — checked via an inbuilt battery probe (for electrolyte level). An inbuilt load resistor enables checks to be made of on-load performance.

Other automobile companies are also working on similar lines to VW. General Motors for example have developed a series of diagnostic vehicles. One such, known as Delta I illustrates how a vehicle can be plugged into a simple data terminal which then uses telephone line connections to a central computer. A second GM vehicle, Delta II, has an inbuilt computer which advises the driver of the status of all critical components and systems.

Other diagnostic units are being developed for use on manufacturing production lines — hopefully to ensure that vehicles have been properly screwed together before sales.

The major difficulty facing the proponents of automated diagnosis is that major car manufacturers are adamantly opposed to standardized plug-in test gear. Their argument is that electronic systems of various cars are not compatible anyway — and apart from that, one manufacturer's service staff would not be able to work on vehicles from another — and vice versa.

No doubt the prospect of being able to ensure that only XY agents service XY cars has not been overlooked.

However in the USA at least, the car manufacturers may soon find themselves with little choice for a Bill, passed both by the Senate and the House last year, may soon require all vehicles to be subjected to diagnostic testing before sale, and after accidents.

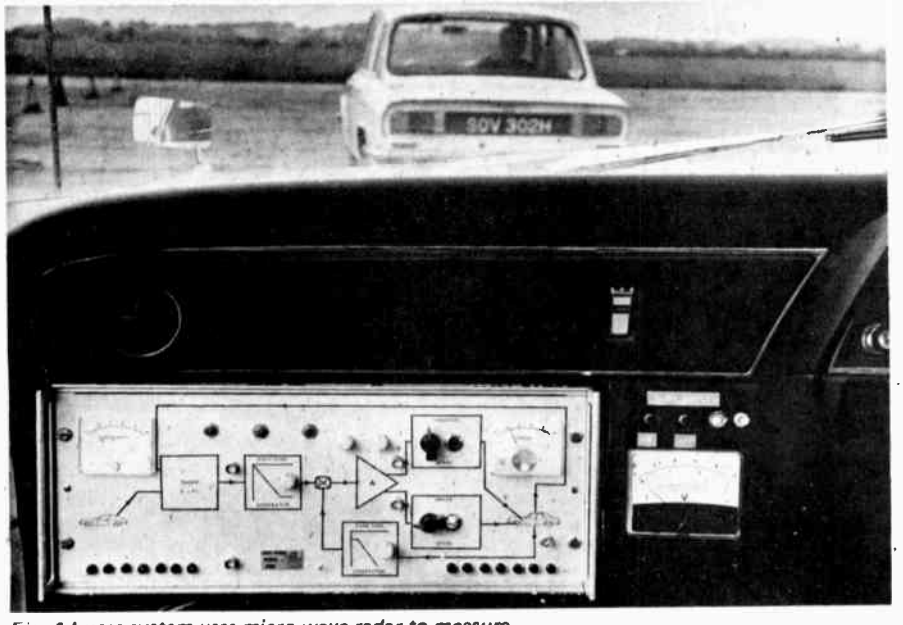


Fig. 4 Lucas system uses micro-wave radar to measure relative speed and spacing of vehicles and then adjusts these values by automatic operation of throttle and brakes.

SAFETY PACKAGES

Having spent several decades insisting that the public would not buy cars in which safety was accented, the autombile industry has done a complete volte-face and some of the less reactionary organisations have admitted that Ralph Nader may even have been right. (The remainder still concentrate on picking out inconsistencies in some of his evidence in the extraordinary belief that this negates the whole of it).

ANTI-SKID SYSTEMS

Such systems have been in common use on aircraft for years, and one or two specialised cars have recently been fitted with adaptations of aircraft systems.

So far these devices work by sensing wheel deceleration — using magnetic sensors. If the deceleration exceeds a predetermined level, an electronic control unit actuates control valves that release brake hydraulic line pressure. A drawing of a typical system is shown in Fig. 3

Once again this in an area in which Government legislation may force vehicle builders to fit anti-skid units. In the USA a Federal motor vehicle safety standard — to become effective in 1974 — is so stringent that braking requirements (for trucks fitted with air-brakes) can probably only be met by installing anti-lock systems. Without doubt these requirements will be extended to cover other classes of vehicle in the near future..

In Germany, Mercedes' plan to install the Teldex anti-locking unit appears to have been delayed by unexpected production difficulties — the price also is reported to be much higher than was originally hoped.

In England, Michael Bertioli, Manager of Lucas' Electrical Circuitry Department recently described an automatic headway system that his department has developed.

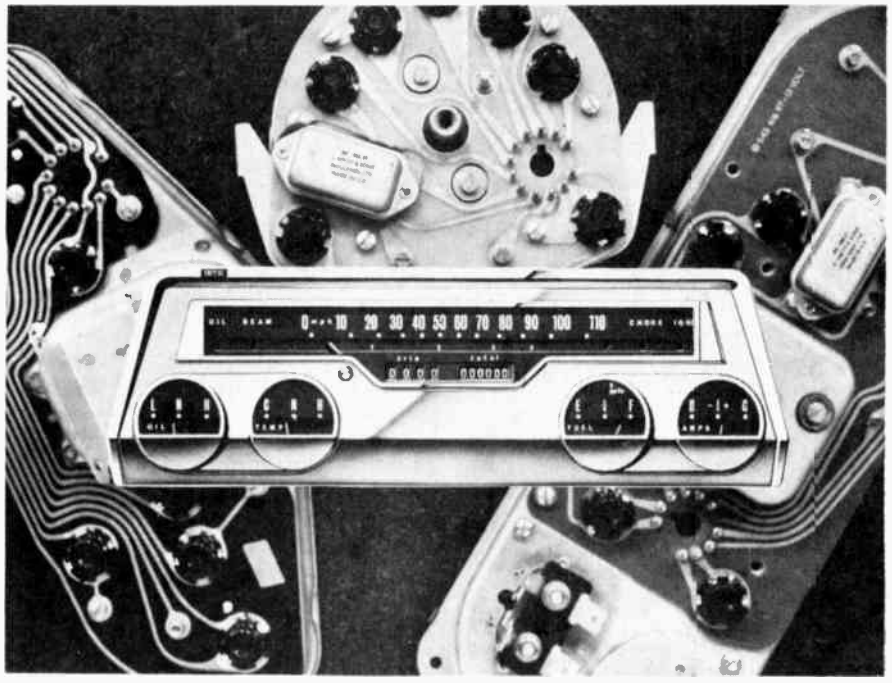
The Lucas system (Fig. 4) uses micro-wave radar to measure the relative speed and spacing of the vehicles and then adjusts these values by automatic operation of the brake and throttle.

Mr Bertioli said that the system would be no larger than a rectangular headlamp and would cost no more than a car radio. However he added that the system would only be completely effective if universally enforced by legislation.

The British Government's Dept. of Environment has awarded some $60,000 for future development of the Lucas scheme.

Although automatic braking systems seem fraught with potential difficulties, industry spokesmen are optimistic. William Miron, President of Bendix Automotive Group said

CARS– FUTURE SHOCK?



All-in-one instrument panel from Smiths uses printed circuit construction and is connected to vehicle's wiring harness via multi-way plug.

recently that the Bendix system could be fitted as an option as early as 1974 – price probably less than $200.

General Motors' view is that radar is still the most promising technique. According to a spokesman from their research laboratories at Warren, Michigan, they have investigated other techniques including lasers and ultrasonics but have rejected them as being insufficiently robust.

Their experiments so far prove that an automatic braking system can be faster, more accurate, and hence safer than a human driver operated system, primarily because the reaction time between recognizing a system as potentially dangerous and taking avoding action is reduced to practically zero.

ANTI-COLLISION

Right from the early days of motoring, as the accident rate continued to climb, 'authorities' explained that accidents were due almost entirely to lack of driver skill."There was no real need to produce intrinsically safe vehicles or even safer roads – all that was required was a higher degree of driving skill."

Fortunately this simplistic view is no longer widely held and it is accepted that the multiple decisions often required in quick succession to avoid collisions may be beyond the ability of the average driver to make.

Hence the move towards automatic control of some vehicle functions. (This area is covered in greater detail later in this article).

The first of such automatic control systems to be given serious consideration is intended to maintain a safe distance between vehicles.

A number of companies are working on these systems including Bendix, Ford, RCA and Sylvania.

Typical of such systems is the ASC (Adaptive Speed Control) from Bendix. This uses a 16 GHz radar beam to detect vehicles at distances up to 100 metres. It relates this data to the speed of both vehicles and to the relative distance between them and automatically brakes or accelerates to maintain a safe following distance.

A basically similar unit from Ford uses an optical beam to provide the distance sensing signal. This (infrared) beam is reflected back to the sensing vehicle by reflectors built into the tailights of the vehicle ahead.

Common to the radar operated systems are problems of jamming and false indication. RCA propose to overcome this by mounting a reflector on the rear of all vehicles, which reflects the received signal at *twice the original* frequency (Fig. 5). However how this system could detect say, a fallen tree blocking the highway, is not known.

ELECTRIC PROPULSION

Even were there no pollution problems, the mere fact that the world has a limited supply of petroleum is a compelling reason to look for sources of motive power other than this type of fuel. In his Message on Energy Resources (June 1971), USA President Nixon clearly warned "we can no longer take our energy resources for granted".

Of the currently known alternative

This prototype vehicle built by Britain's Electricity Council's Research Centre is powered by sodium sulphur battery. The battery is one fifth weight of conventional lead acid batteries and gives vehicle a range of 100 miles at 40 mph.

fuel sources suitable for transportation requirements, the most appealing is electricity.

Electricity, whether derived from storage batteries, fuel cells or from a central power station, is far less polluting *at the point of use* than petroleum derived energy. It makes more efficient use of our most readily available energy sources. It is silent, and because of the efficiency of electric machines, it gives off less heat during vehicle operation.

But until recently there has been a widespread feeling that no worthwhile progress could be made in the development of electrically powered vehicles until batteries with much greater storage capability per unit weight became available.

This view is no longer so widely held and a surprisingly large number of companies all over the world are actively developing or producing specialised vehicles.

A great deal of effort is going toward battery development, and it is now generally agreed that a battery with an energy density approaching 100 watt-hours a pound, a power density of 50 watts per pound, and made of cheap materials can be developed. Such a battery could power a 2 500 pound four-seat car and provide it with a top speed of 80 mph – cruising speed of 50 mph and a range of 150-200 miles.

At a meeting of the International Union of Producers and Distributors of Electric Energy held in Brussels in March 1972, the Union's Executive Secretary, Jack Young said 'There are a number of electrochemical solutions to the problems implied by these requirements (i.e. production of a battery with specifications outlined above). While all technological forecasting must be on shaky ground, it is our impression that two or three years – and a lot of work – should produce a commercially feasible battery of the characteristics I have been discussing'.

If this sounds optimistic consider these facts –

1. The USA's Federal Power Commission's National Power Survey recently forecast 38 million on-the-road electric vehicles by 1990.
2. The USA's Environmental Protection Agency forecasts 40 million vehicles by the same year.
3. Even the Shell Oil Company is forecasting five million electric vehicles by 1985.
4. In Germany, Volkswagen AG and RWE AG (the largest electric company in Germany) are jointly developing an electrically powered version of the Kombi. If successful the combine plan to have 200 experimental vehicles running by 1974.

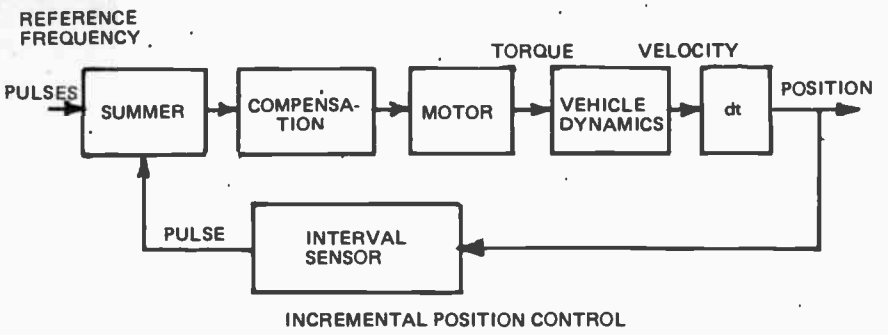


Fig. 6 Incremental position control

5. Japan's Ministry of Trade and Industry has commissioned a $14 million program to develop a better type of lead-acid battery and five types of electric cars and vans. Thirteen companies including, battery manufacturers, car manufacturers and electrical supply authorities are working together to have the vehicles on the market by 1975.
6. In France, the government-owned electricity supply authority 'Electricite de France' is currently building 60 experimental electric cars based on the Renault 4L. This year the company will build a further 100 vehicles to test the possibility of launching into full scale production.
7. In Zermatt in Switzerland, a town of 2 800 inhabitants with up to 13 000 visitors, all transport is by electric vehicles. No other form of motive power is allowed.

From an electronic engineering point of view a change to electric propulsion removes many of the difficulties which currently arise because of the need to interface between two quite different technologies.

It also simplifies any future move toward automated guideway transportation systems – which many authorities feel may eventually be used for transportation both between and within cities.

AUTOMATED GUIDEWAY TRANSPORTATION

Ironically, the motor vehicle – originally conceived as a means of providing individual mobility, has (because of its practically universal acceptance) become a threat to that very same concept.

We cannot *ban* the automobile, rather we must devise ways in which the automobile can better be adapted so that it becomes more harmonious with our primarily urban style of life.

Present indications are that our

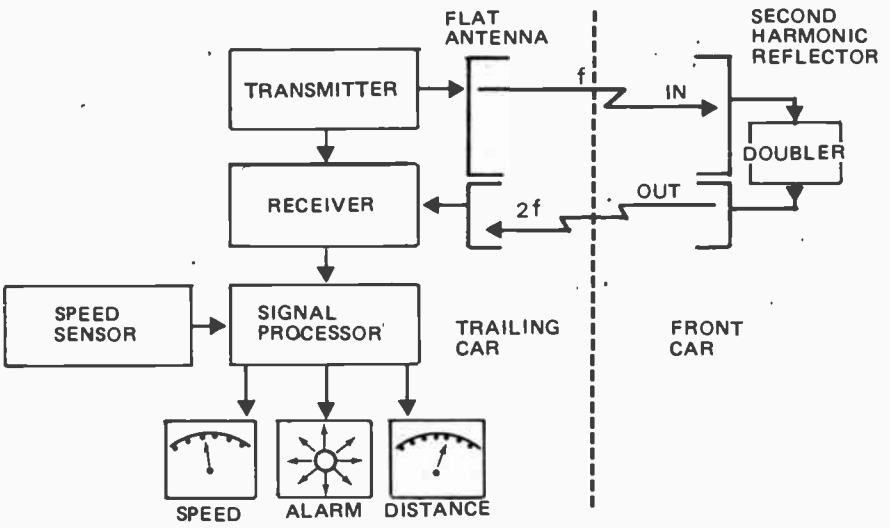


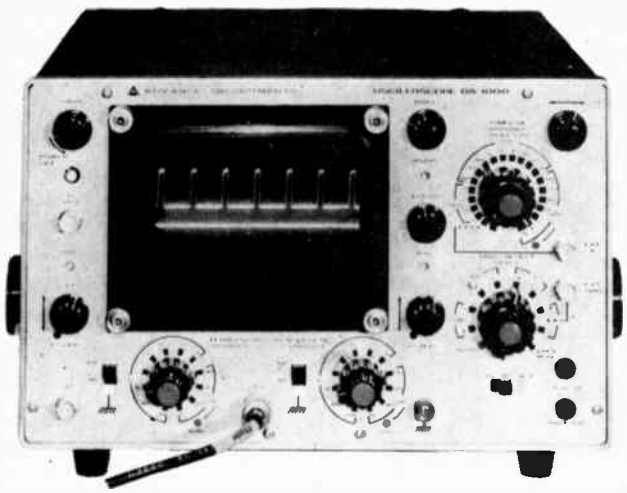
Fig. 5. RCA anti-collision system. Transmitter radiates 9 GHz vertically polarized beam. Signal is picked up and 'Passive' antenna on target car uses diode micro-strip filters to re-radiate signal back to following car at twice the frequency (18 GHz). Polarization is also changed to horizontal. Technique is claimed to eliminate background noise. The system provides audible and visual warning if vehicles are too close for safety.

Two new instruments from ADVANCE

which offer

UP-to-the-minute performance and latest 'state of the art' technology

DOWN-to-earth prices



OS1000 oscilloscope

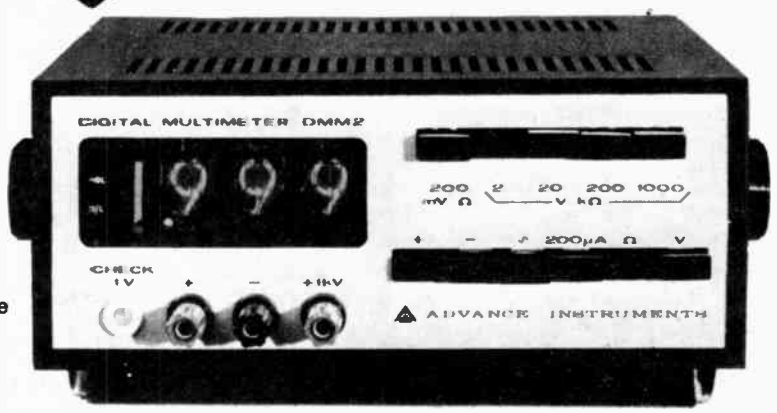
OUTSTANDING FEATURES • DC to 15 MHz bandwidth • 5mV/cm dual trace • Signal delay • Comprehensive trigger facilities, incl. TV sync. • Bright line auto free-run • Switched X-Y operation

The ADVANCE OS1000 is a portable, dual trace oscilloscope, combining small size and light weight with a specification providing the ability to make precise waveform measurements. Wide time base ranges and comprehensive trigger control combined with broad bandwidth and calibrated deflection factor make this instrument suitable for many general purpose and laboratory and TV applications. Use of solid state circuitry throughout makes the OS1000 particularly suitable for servicing or laboratory use.
Full specifications available on request.

DMM2 digital m/meter

OUTSTANDING FEATURES • 17 ranges for measurement of AC or DC voltage, current and resistance • Maximum stability • LSI reliability

The DMM2 Digital Multimeter provides in 17 ranges a clear digital reading of AC or DC voltage, AC and DC current and resistance. Push button selection of functions and ranges. The display has a max. reading of 1999 with automatically positioned decimal point. Overrange and reverse polarity indications are provided. The DMM2 weighs only 3½ lb and can be operated from AC supply, external 12V DC, or an optional rechargeable battery pack. Design ensures maximum stability for all measurements, ease of operation allowing use by non-technical operators and high reliability with all counting and storage functions performed by an LSI package (Large Scale Integrated Circuit). Full specifications available on request.



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CARS– FUTURE SHOCK?

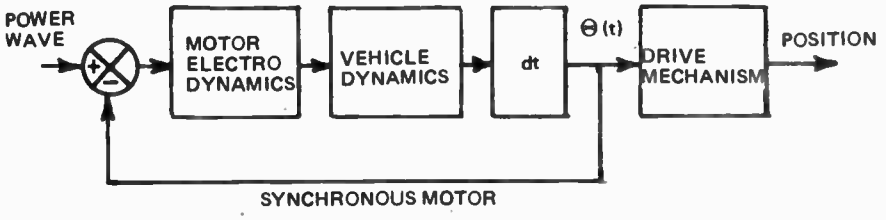

Fig. 7 Synchronous motor control

future transportation will consist of independently powered vehicles which can be individually (manually) controlled as at present, but capable also of travelling more or less synchronously on automated guideways.

Three basic control systems are currently being investigated by the US Dept. of Transportation.

Central control – in which each vehicle's position and velocity is determined by a central computer which receives data from the vehicle itself – or from wayside sensors. Velocity commands are then sent at regular intervals to each vehicle. However because of the large number of vehicles involved this does not appear to be a feasible approach.

Incremental local control – A sensor on the vehicle counts distance increments over time and compares the result against a prescribed position/time profile to generate an error signal. A periodic absolute-position signal is used to update the data and thus prevent the accumulation of position errors. (Fig. 6).

Typical of proposed systems of this type is to match the frequency of passing magnetic or electrical discontinuities with a reference clock signal. In effect the vehicle is 'phase-locked' into the guideway.

Local moving wave – This technique involves reading absolute position from a reference wave. A synchronous motor for example would be a direct mechanical implementation of this concept. However to qualify as an absolute position controller, the transformation from rotational to linear motion must be exact – as through a rack and pinion drive. (Fig. 7)

An alternative method involves a moving information wave which gives the vehicle a direct indication of its relative position error at all times. This is equivalent to reading the position from a fixed wayside marker. By presenting the information as a wave, a time and position reference is provided. The vehicle then follows the null point of one of the wave cycles as it moves down the track at prescribed speed. (Fig. 8).

Extraordinary precautions are being considered to reduce accident rates to a very low figure. The current target is that personal injuries should not exceed 1.86 per million vehicle/miles – and fatalities should not exceed 0.2 per million vehicle/miles.

Automated guideways systems may also be co-ordinated with, or backed up by, Personal Rapid Transport (PRT) systems.

Common to most PRT systems is the concept of small independently powered vehicles travelling along controlled guideways. In use a

Turn over to page 90.

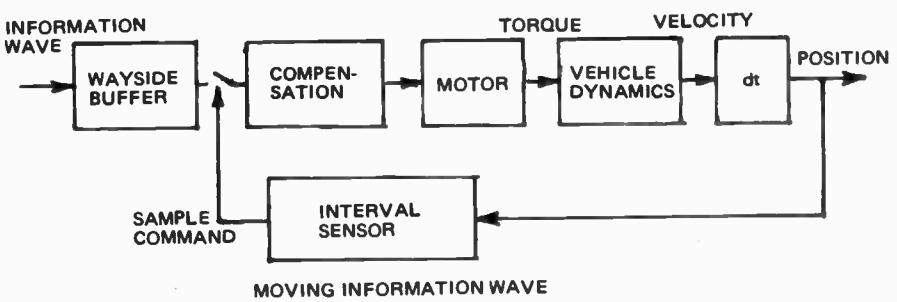

Fig. 8 Moving information wave.

Late night ballad or

Relaxing late at night calls for soft lights and subdued music. So you need a system that will reproduce for you in true high fidelity all the high, mid range and bass sounds in their correct relationship for civilised nocturnal aural enjoyment . . . even though they're toned right down to baby sound levels for soothing background effect. A swinging party could just need plenty of sound power . . . for dancing or background music . . . and yet not overstretch the budget. Kenwood gives the right system . . . on both counts.

KENWOOD . . . with its range of stereo amplifiers, turntables and speakers—and now 4-channel decoders for addition to your existing system—gives you *all* the options you need to create *your* sound just how you want it.

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PATIO PARTY

LEFT—This system comprises units to give the ultimate in sound. The KA-6004 amplifier has exceptional stability over the entire frequency range of 20 Hz to 20 kHz . . . from ultra low range to far above the limit of audio frequency. Delivers up to 40 watts per channel. KP-3021 turntable offers really smooth operation auto play, return, repeat and stop—saves your discs, too. KL-777 bowline 6-speaker enclosures reproduce anything in clear sound without distortion. Tone selector for soft, clear or normal. The ultimate in speakers. $1,110 approx. RRP.

RIGHT—For the swingers, good sound for any party. The KA-2002 stereo amplifier is compact and good looking outside and all silicon transistorised inside for ear-raising sound performance. Tone controls to suit room acoustic conditions. The KP-2022 stereo turntable has smooth, even turntable rotation with auto-return and auto-cut mechanism to obviate disc or stylus damage . . with soft-as-a-feather tone-arm action. The KL-2090 bookshelf speakers have remarkable bass response. Can also be wall-mounted vertically or horizontally. Most attractive grille. Altogether a sound setup to please partygoers. $420 approx. RRP.

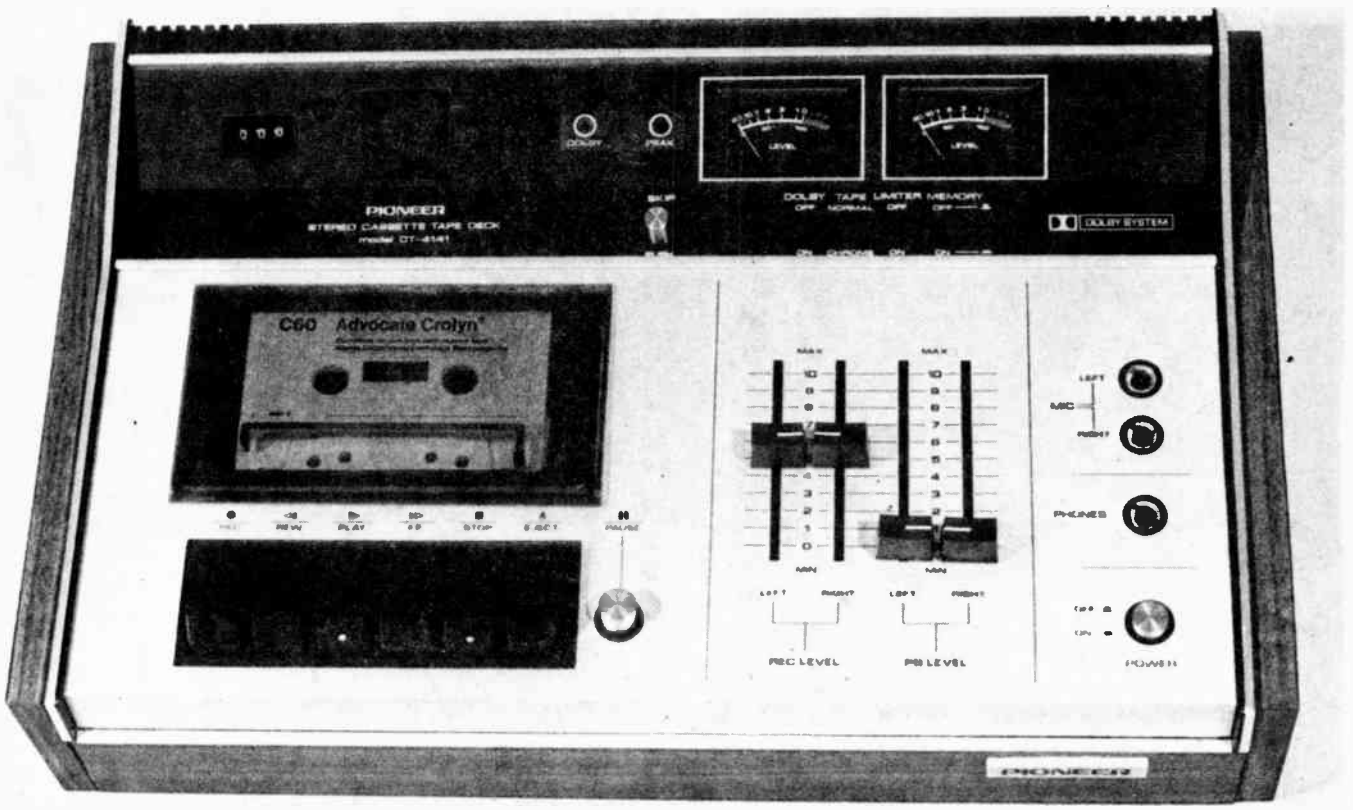
•

You need to *hear* as well as see . . . because with Kenwood you can tell the quality by the sound. Ring any of the phone numbers listed for informative literature and location of your nearest Kenwood Sound Centre.

PIONEER CT 4141 CASSETTE DECK

Frequency response of new Pioneer cassette deck rivals reel-to-reel machines

electronics TODAY INTERNATIONAL
product test



With the introduction of the Dolby Noise Reduction System and chromium dioxide recording tape, the majority of cassette recorder manufacturers quickly developed units incorporating Dolby circuitry, together with the (practically essential) facilities for changing the bias level when using chromium dioxide tape.

But Pioneer was an exception to this trend for the company has only recently released a Dolby cassette recorder. Those who have waited for this unit to appear will not be disappointed.

The Pioneer CT 4141 includes a number of very practical features – that we have not seen on any other cassette recorder. In particular, there is a "skip" button and a 'memory' button, which we will describe in more detail later in this article.

At first sight, the unit seems to be a copy of the latest trend in cassette recorder shapes. But whilst this is partly true, additional novel and practical features give the Pioneer unit a character of its own.

The top panel is divided into two main parts, the front section, which is approximately 6" wide, is a brushed aluminium panel and contains the following facilities:–

The left hand side has a row of six piano-key type switches across the front. These are for record, rewind, play, fast forward, stop, and cassette eject. To the right of the eject key is a 'push on' 'push off' pause key. Behind

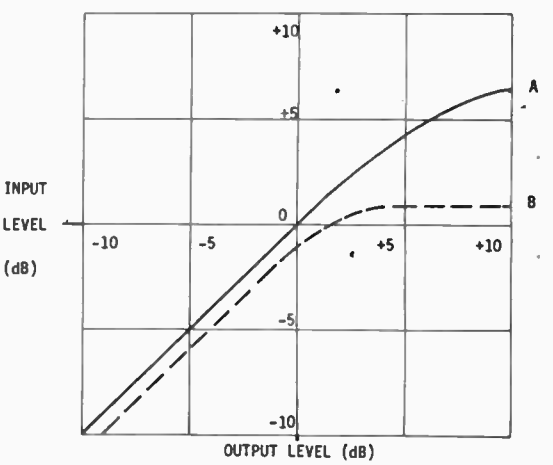


Fig. 1. Transfer characteristics of recorder showing the effect of compression circuit. 'A', is a curve obtained using no compression 'B', is a curve using compression.

the six key switches, which are black and have a narrow block surround around them, is the cassette-well with a smoked perspex cover, chamfered on all edges.

The righthand side of the brushed aluminium panel has four slide potentiometers mounted side by side and located adjacent to the cassette-well. The first two potentiometers are for record level, left and right channel respectively. The second two are for playback level controls. These controls are linearly graduated from 0 to 10.

The left and right channel microphone inputs, the headphone output socket, and the power push button, are arranged in line down the righthand side of the panel. Tip and sleeve sockets are used for the microphone inputs, and a ring tip and sleeve socket for the headphones output. The power switch is a push-on push-off button.

The back section of the panel is all black and consists of a flat section with a number of pushbuttons, and a sloping section with the VU meters and indicators. The push buttons on the flat section are, from left to right:—

a) A hold down skip button (or cue button). This is only operative in the play mode and feeds the tape through at twice the normal speed of 1-7/8" per second (i.e., at 3¾" per second) with the playback head engaged. This is an excellent feature and one that we have not seen on any other cassette recorder. It makes it possible to find a passage in the middle of a tape without having to hop from fast forward to stop, to play, to stop, to rewind etc, as is the case on all other machines we have seen unless one hand manipulates the play button.

b) A set of four rectangular "push on" "push off" buttons which provide the following:

i) 'Dolby noise reduction' switching.

ii) 'Tape equalization level 'normal' or 'chromium' '

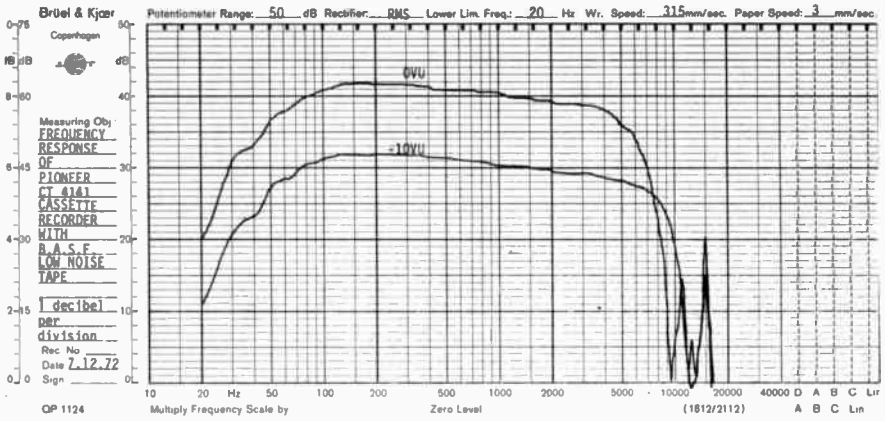
iii) 'Limiter' switch which when selected, switches in a compressor circuit to reduce any excessive transients. (The response of this compression circuit is shown in Fig. 1).

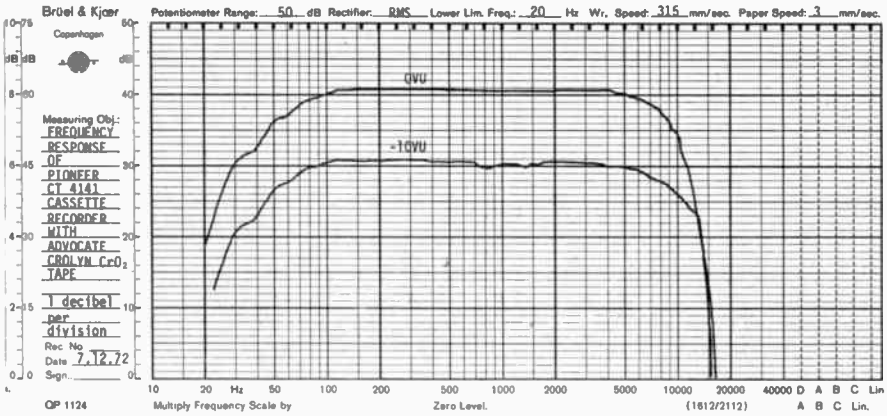
The use of this compression circuit resulted in a significant reduction in distortion (as seen in Fig. 2).

An interesting feature is that when the compression circuit is in use, the VU meter and the peak indicator light still operate on the input level *before* compression.

iv) A memory switch which works in conjunction with the counter. When this switch is selected and the rewind key pressed, the tape will automatically rewind to zero and stop. This means that if you wish to start a recording in the middle of a tape you can press the memory button, set the counter to zero and then, if you make a mistake during recording or you want to go back and hear what you have recorded, it is only necessary to press the rewind button and the tape will automatically stop when it gets to zero, eliminating any tedious cueing.

The sloping section of the panel, which is fluted, has a resettable tape counter at the left hand end. This counter has yellow numerals on a black background. This is more easily read than the usual white numerals on a black background. To the right of the counter is a novel tape-run indicator. It consists of light rotating behind a segmented bezel. The light rotates at the same speed as the tape, being synchronized with the take-up spindle, and therefore immediately indicates if the tape has jammed or stopped. When recording, the yellow





Frequency response of machine as received. ABOVE: Using BASF low noise tape. BELOW: Using Advocate Crolyn tape.

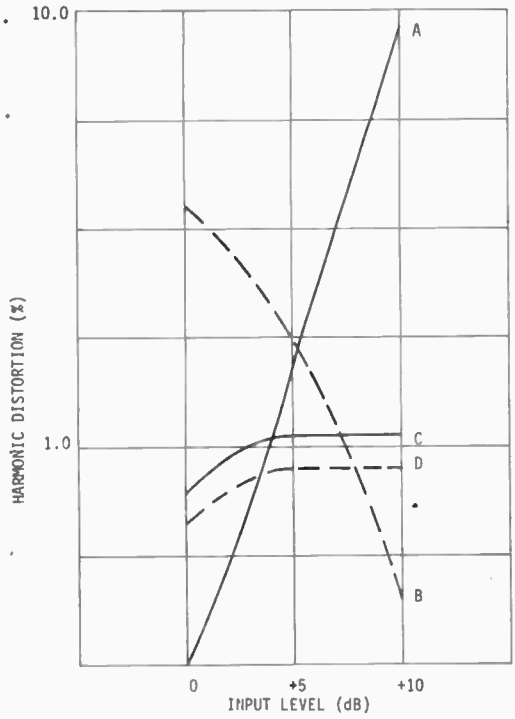


Fig. 2. How compression reduces distortion of the recorded signal.
A) 3rd. harmonic — without compression
B) 2nd. harmonic — without compression
C) 3rd. harmonic — with compression
D) 2nd. harmonic with compression.

ELECTRONICS TODAY INTERNATIONAL

EDITOR

Apart from the Australian edition, Electronics Today International is now published in England and France. It is our intention to continue the present rate of expansion for some time to come.

Because of this we are now seeking an editor for one of our future overseas editions – which is to be published in an English speaking country within the British Commonwealth.

Applicants must have extensive knowledge and practical experience of all aspects of electronics and audio, and must also have the ability to describe complex matter in clear, concise English.

Journalistic, public relations, sales or business experience would be advantageous but not necessarily essential.

Salary will be based on qualifications and experience but will be commensurate with the responsibility involved.

Written applications (which will be treated as confidential) should be addressed to:–

Collyn Rivers
Editorial Director,
Electronics Today International,
21-23 Bathurst St.,
Sydney, 2000.

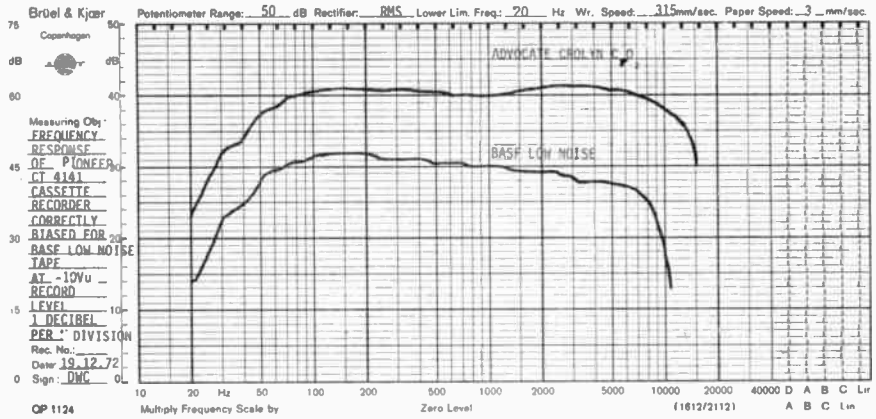
PIONEER CT 4141 CASSETTE DECK

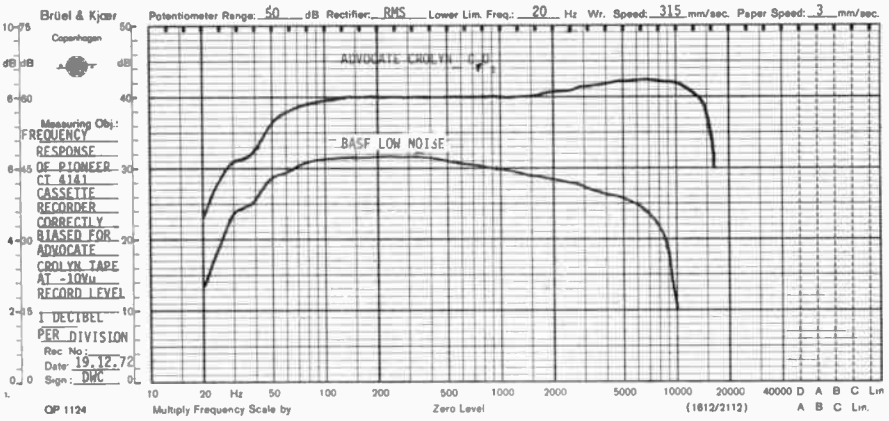
globe is extinguished and a red globe now indicates that the record mode has been selected.

To the right of the tape run indicator are two small indicator lights. The first one is blue and indicates that Dolby noise reduction has been selected. The second one is a red light for indicating peaks and this indicates that distortion causing peaks are occurring in the music. The light supplements the inbuilt-VU meters which because of their response time and circuit characteristics, do not always respond to sharp transients (which may cause distortions).

The two VU meters are located directly above the slide potentiometer on the sloping section. The meters are illuminated when the power is on and are accurately graduated +3, +2, +1, 0 −1, −3, −5, −7, −10, and −20dB. All input and output sockets are located on a recessed panel in the back of the recorder. They consist of two pairs of R.C.A. socket for line input and line output respectively, and one DIN combination record playback socket. Each end of the recorder has a veneered timber edging.

All the potentiometers on the main board are clearly marked to facilitate adjustments. These include the bias level adjustment potentiometers, equalization adjustment potentiometers and playback adjustment potentiometer – to name a few of the eighteen adjustment points that we could see.





The Dolby Noise Reduction circuit is located on a separate board mounted on edge at one end of the chassis. The fuse in the unit reviewed was soldered in place internally but we understand that later production models have an externally accessible fuse. The record-playback head uses a ferrite magnetic material to minimise the wear which may occur with some

MEASURED PERFORMANCE OF PIONEER CT 4141 CASSETTE RECORDER SERIAL NO. SF 13011

Frequency Response (Factory set bias)
Advocate Crolyn C_rO_2
0VU 50Hz to 8.5 kHz $\pm \frac{1}{3}$ dB
(optimized bias)
−10VU 50Hz to 9 kHz $\pm \frac{1}{3}$ dB
−10VU 50Hz to 16 kHz $\pm \frac{2}{3}$ dB

Frequency Response (Factory set bias)
BASF Low Noise
0VU 50Hz to 4 kHz $\pm \frac{1}{3}$ dB
−10VU 50Hz to 7 kHz $\pm \frac{2}{3}$ dB

Total Harmonic Distortion (at 1 kHz)
0VU = 0.8%
−10VU = 0.1%

Intermodulation Distortion
1 kHz & 960Hz
0VU = 0.1%
−10VU = 0.06%

Signal to Noise Ratio (with respect to 1kHz at 0VU)

	With Dolby	Without Dolby
Unweighted	49dB	49dB
'A' Weighted	58dB	53dB

Erase Ratio For 1kHz at 0VU
−67dB (BASF Low Noise)
−72dB Advocate C_rO_2

Cross Talk at 0VU

100Hz	40dB
1kHz	40dB

Wow and Flutter
0.03% rms

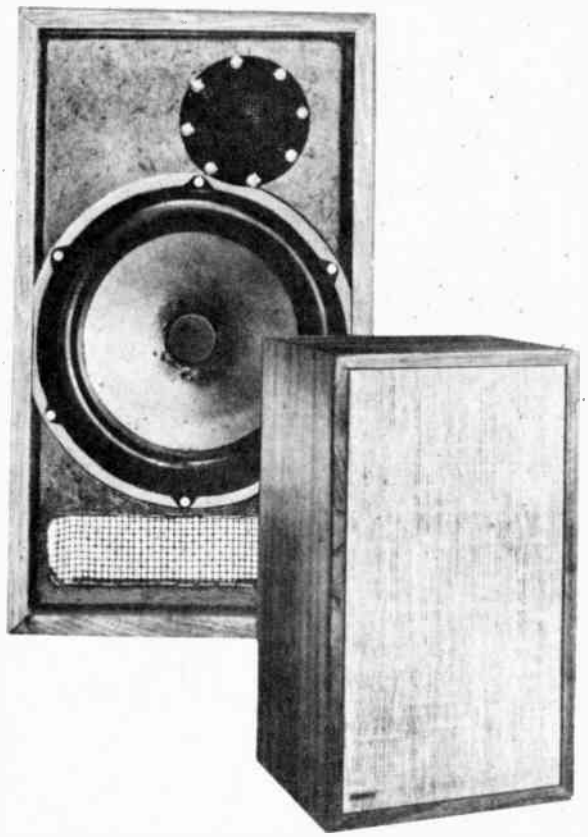
Speed Error
+ 0.05%

Line Input Sensitivity For 0VU
250mV

Maximum Line Output
(0VU input – BASF low noise tape)
900mV

"...(The Dynaco A-25) has established a new standard of performance in uncolored, natural sound."

THE HI-FI NEWSLETTER (P.O. Box 539, Hialeah, Fla. 33011)



"...you'll have a hard time buying more musical naturalness at any price."

THE STEREOPHILE (Box 49, Elwyn, Pa. 19063)

The critiques from these hobbyist magazines have unusual merit as these publications accept no advertising. Their comparative evaluations are funded solely by the subscriptions of ardent audiophiles.

The A-25's sound quality is a direct consequence of its smooth frequency response, outstanding transient characteristics, and very low distortion. Its aperiodic design (virtually constant impedance over its range) provides an ideal load so any amplifier can deliver more undistorted power (and thus higher sound levels) for a given speaker efficiency.

Uniformity of impedance also makes the A-25 the best choice for adding two new speakers to an existing stereo setup using the Dynaco system* for four-dimensional reproduction. In this way, true "concert hall sound" can be enjoyed with a standard stereo amplifier.

See and hear two additional Dynaco models, the A10 and A35 with markedly similar sonics and closely matched characteristics at your Dynaco dealer now. Together with the A25, these models represent the finest value available today.

FOR YOUR NEAREST DYNACO DEALER, WRITE OR PHONE

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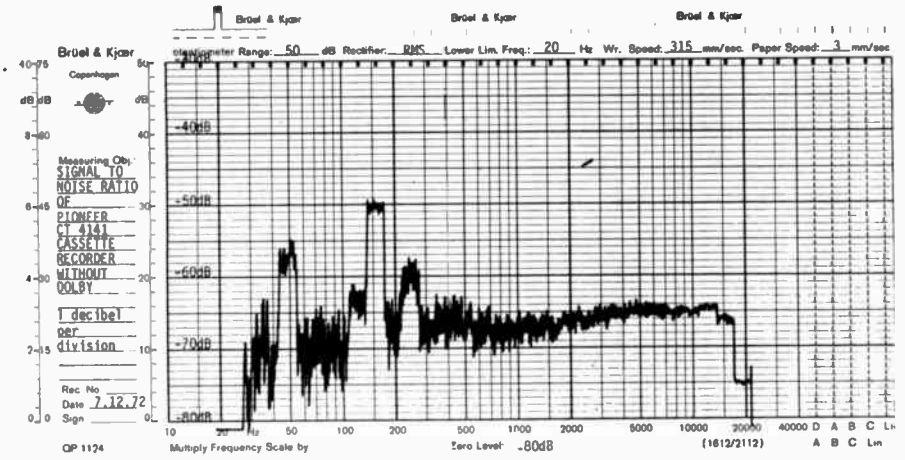
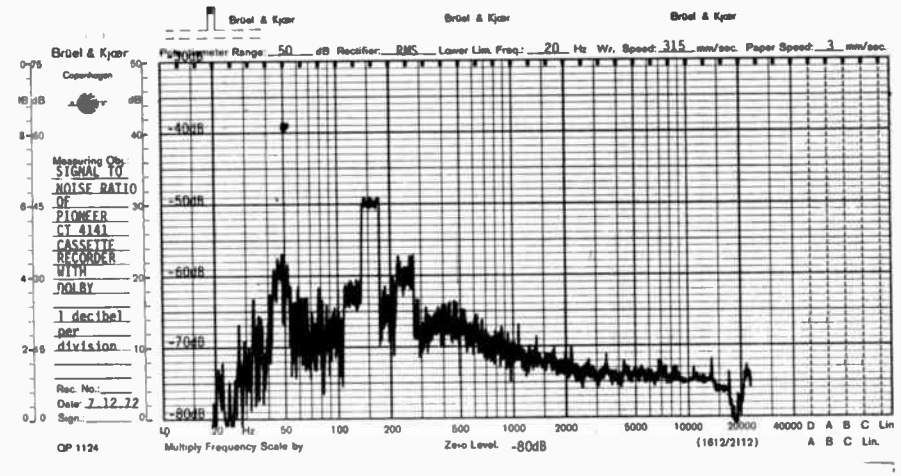
PIONEER CT 4141 CASSETTE DECK





chromium dioxide tapes on normal iron heads.

We were surprised to find that the iron oxide/chromium dioxide tape switch changed only the record *equalization* and not the record *bias*. This results in a less effective system, and one that can be correctly biased for only one type of tape.

To check this out we firstly adjusted the bias with the switch on the chromium dioxide position and obtained a frequency response to 16 kHz using Advocate Crolyn tape. Using the same setting but this time with BASF tape and with the switch set to the iron oxide position, the results were very poor with a frequency response to 4 kHz only.

We then tried to adjust the bias with the switch in the iron oxide tape position and using BASF tape. This resulted in a marginal improvement.

The equalisation circuit – with the bias switch in the iron oxide position – appeared to limit the performance of the machine when using conventional iron-oxide tapes. With the switch in the chromium dioxide tape position it is possible to obtain a further improvement in frequency response of *iron oxide* tapes – but this seems to negate the purpose of having the switch in the first place.

This machine appears to have been made primarily for use with chromium dioxide tapes and if these are used the frequency response rivals that of full reel to reel machines.

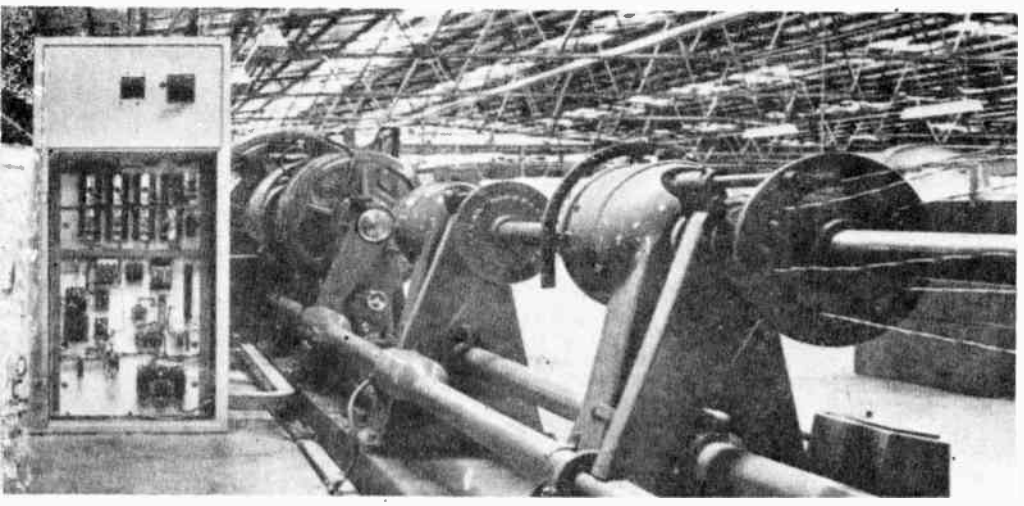
Wow and flutter signal to noise ratio, and distortion, were the lowest we have measured on any Dolbyized cassette recorder to date.

With the exception of frequency response, which with a change of bias level was improved to 16 kHz, the Pioneer CT 4141 is one of the best Dolbyized cassette recorders we have seen to date. At a recommended selling price of $320 it is competitively priced and offers a number of worthwhile features not currently seen on other cassette recorders in the same price range. ●

Recommended retail price – $320

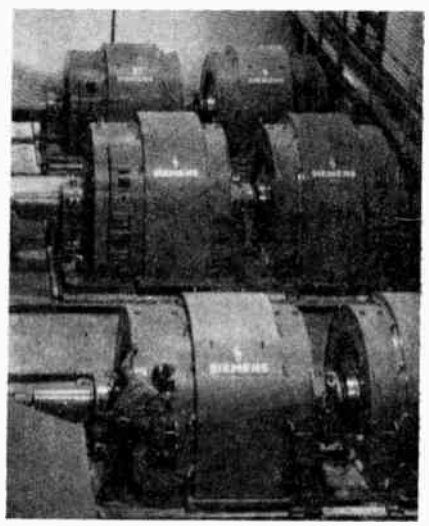
VARIABLE SPEED DC DRIVES

Throughout science and industry, variable speed dc drives power innumerable processes — from fractional to 75 000 horsepower.



A surprisingly large number of industrial and scientific processes require a motor or motors that can be controlled accurately over a wide range of speed.

This magazine for example is printed on a press in which over twenty separate motors are controlled in automatic synchronization to reel off paper, print in one or more colours on both sides of the paper, cut the sheets and fold them in the right order — all at incredibly high speed.



Massive SCR-controlled drive motors provide power for a reversing cold-rolling mill at a German steelworks. Total connected load is 13.4 MW. The drives operate at 450 rpm and provide strip tensions of up to 450 MN.

Many of these variable speed applications are handled by systems known generically as 'dc drives'.

These drives operate from standard ac power lines. They rectify and control this current to regulate precisely the speed of dc motors over a very wide speed range. They can be remotely controlled — either manually or automatically, or regulated by variables such as pressure, temperature, flow rate, etc.

Drive systems such as this are self-compensating to maintain set speed regardless of changes in load. Several motors, individually adjusted to any desired speed, may be controlled as a group from a master speed control or signal. They have been produced in sizes ranging from fractional horse power systems for scientific instrumentation to mammoth rolling mill installations approaching 75 000 horsepower.

Common to all these installations is some form of dc motor, and despite the fact that dc motors cost twice as much as ac motors of the same horsepower and require more frequent and more expensive maintenance, the ease with which these motors can be controlled makes them a versatile choice for the design of drive systems, and for this reason they have been used extensively in process control for many years.

METHODS OF CONTROL

The simplest method of controlling the speed of a dc motor is to vary the supply to the armature, or field windings, or both. Such straightforward control which does not incorporate feedback of any kind is known as "Open Loop". Open loop control is used for applications where high setting and regulation accuracies are not required (such as fans, food mixers and electric traction).

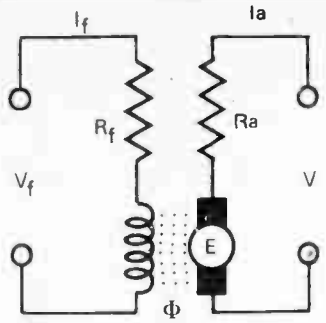
Until the late 40's and early 50's, the most common method of varying the armature and field supplies was by means of rheostats or switched resistors in series with the supplies.

In the early to mid 50's, thyratrons (gas-filled gated-rectifier valves) dominated the scene and were coupled with a 'phase control' system of converting the ac mains into a regulated and variable dc supply for the motor armature. Metal oxide rectifiers were commonly used to supply fixed field excitation. In the late 50's, various other techniques were briefly used, e.g. saturable reactors, magnetic amplifiers and power transistors (for the smaller machines).

Then in the early 60's power diodes and SCR's of suitable rating became available, making the construction of economical dc drives possible. Details of SCR control systems are given in an accompanying box on page 35.

Most industrial processes require a higher degree of accuracy than can be provided with open loop systems. For example, in automatic assembly equipment, component arrival cannot be allowed to get out of sequence, hence some information has to be fedback to the drive to compensate for cumulative errors. Such a system, where "feedback" is used to correct the process, is known as a "closed loop" system.

Closed loop systems rapidly became accepted as manufacturers realized that feedback systems allow processes to continue at higher speed whilst producing more consistent results. Indeed much of the produce we use could not be economically manufactured without the use of closed loop systems.



THE DC MOTOR

Figure 1 shows a simplified equivalent circuit of a dc motor – the circuit is equally applicable to separately excited generators and shunt-wound dc motors – the most commonly used machines.

The magnetic flux (Φ) created in the machine by a current (I_f) in its field winding is determined by the excitation voltage (V_f) and cumulative resistance (R_f) in the field circuit.

In the case of a motor, the speed at which the armature rotates is determined by the relationship between the applied voltage (V) and the armature current (I_a). This relationship is $V - E + I_aR_a$, where E is now the back emf generated by the armature winding (and is proportional to the flux (Φ) and the rotational speed (N).

The torque developed by the motor is proportional to the armature current and flux; the horse power is proportional to torque and speed.

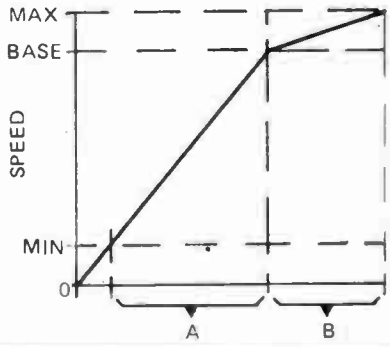
SPEED CONTROL OF DC MOTORS

Since speed is proportional to $(V - I_aR_a)/\Phi$, either the applied voltage (V), or the field excitation, may be varied to provide control. (In some applications both the applied voltage and the field excitation may be varied. The effect on motor speed of varying the supply voltage and the field excitation is shown (in idealized form) in Fig. 2.

With field excitation held at maximum (part A of the graph), the speed increases with increasing supply voltage from zero to the 'base speed' of the motor; the useable part of this range is usually a 20:1 or 30:1 range from base speed to minimum speed (e.g. 1500 rpm to 75 rpm). Over this speed range, since torque is proportional to $I_a\Phi$ and as Φ is held constant, the motor produces constant torque, hence horse power is directly proportional to speed.

The motor speed can be increased beyond the base speed of the motor (to an extent determined by the motor construction) by holding the supply voltage at maximum and reducing field excitation. This mode of operation is shown as 'B' in Fig. 2. In this mode, the ΦN product remains constant and, since horsepower is proportional to $I_aN\Phi$, the motor produces constant horsepower.

In practice the transition from base to maximum speed is not as clean-cut as shown in Fig. 2. When a motor is required to be controlled over the whole range from minimum to maximum speed, the effect of reducing field excitation and increasing supply voltage overlap to some extent.



CLOSED LOOP CONTROL

Reduced to basic principles, a closed loop control system has the elements shown in Fig 3. The 'speed reference' input is in terms of the value at which the 'controlled parameter' is to be adjusted or maintained. The 'feedback' is in terms of the actual value of the controlled parameter. Depending on the type of control required, the speed reference input may be obtained from a manually adjusted device (such as a potentiometer calibrated in rpm), a calibrated transducer or the programmed output of another system.

Depending on the variable which is to be controlled, the feedback input (which always opposes the reference), gives a measure of speed, temperature, pressure, tension, flow-rate or whatever is appropriate to the process. The control circuits are designed to always seek and achieve a dynamic balanced state (called the 'steady state') where the reference, feedback and control signals are such that the required set condition is attained.

Thus the essence of closed loop control is that the reference and feedback are continually compared and the resultant 'control' input amplified and otherwise processed so as to control the final parameter.

ARMATURE VOLTAGE FEEDBACK

Closed loop control, as applied to the regulation of motor speed by using armature voltage feedback, is shown in Fig. 4. The maximum and minimum values of the reference voltage (V_{ref}) set by the 'speed control' potentiometer are determined respectively by RV1 and RV2. The armature voltage is taken as an approximate measure of the back-emf and hence the motor speed; from this is obtained the feedback signal V_{fb}. Resistors R2 and R3 compare V_{fb} with V_{ref} to yield the control signal V_c which is amplified and used to control the timing of firing pulses applied to the SCRs in series with the motor armature. Full motor excitation is constantly applied by a separate rectifier circuit also operating from the ac supply.

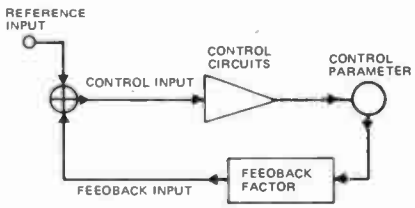


Fig. 3. Basic closed loop control system.

With increase of reference voltage (V_{ref}), or decrease of feedback voltage (V_{fb}), the system operation is as follows:–

1) The amplifier output swings positive thus advancing the firing pulses.
2) The SCR's switch on for a greater portion of the half-cycle.
3) Supply voltage, and hence armature current increase.
4) The speed of the motor and the feedback voltage increases until the original change in voltage is compensated.

VARIABLE SPEED DC DRIVES

VARIABLE SPEED DRIVES

In this feature, electronically controlled dc drives only are mentioned. There are, of course, other forms of variable speed drives in use today. Many use an ac, motor as the prime mover and, since the speed of an ac motor is determined by the mains frequency and is not smoothly variable over such a wide range as a dc motor, some form of speed-varying mechanism is used between the motor output shaft and the controlled load. Of these mechanisms, fixed-ratio and variable-ratio gear boxes operating on purely mechanical principles are well known. A not-so-well known technique is the use of eddy-current coupling in which an electromagnetic clutch provides variable coupling between the motor and the driven shaft, this coupling being proportional to the excitation current (dc) supplied to a stator in the clutch.

Speed control of an ac motor has also been developed recently. One technique is to use thyristors connected back-to-back to control the ac voltage applied to a squirrel-cage induction motor; this is not a particularly satisfactory method due to the decrease in load power factor at low speeds. More satisfactory methods rectify the current flowing in the rotor of a slip-ring wound-rotor induction motor and use thyristors to feed back this current to the ac supply. The main advantage of this method is that power that would otherwise be wasted is fed back to the supply, thus improving overall efficiency.

Lastly, more sophisticated methods use static — ac-to-ac converters in which the frequency of the outut supply can be varied and hence the speed of the ac motor operated from this output; the converters are all-electronic and use thyristors to synthezise sine-wave ac of variable frequency, amplitude and power.

5) The motor stabilizes at the new speed.

The same logic applies in the reverse case only with opposite system changes.

When the load on the motor is increased, the speed tends to fall due to the voltage drop across the armature resistance due to increased armature current. This may be compensated by feeding back a voltage proportional to armature current so that it aids the reference voltage. This process is known as IR compensation.

With a circuit employing these principles, speed regulation of 2 to 3% from no load to full load may be achieved. Typical applications include automatic assembly equipment, packaging machinery, printing presses and pumps.

TACHO FEEDBACK

For more precise speed regulation, of the order of 0.1% to 1%, a permanent-magnet dc generator is coupled to the non-driving end of the motor shaft so that its dc voltage output is proportional to motor speed. The tacho generator may also be coupled to the conveyor, or other line driven by the motor, if the linear speed of the line is of importance. Note that in armature supply regulator systems using tacho feedback there is no need for IR compensation, as in armature voltage feedback systems, to compensate for the effect of load on speed.

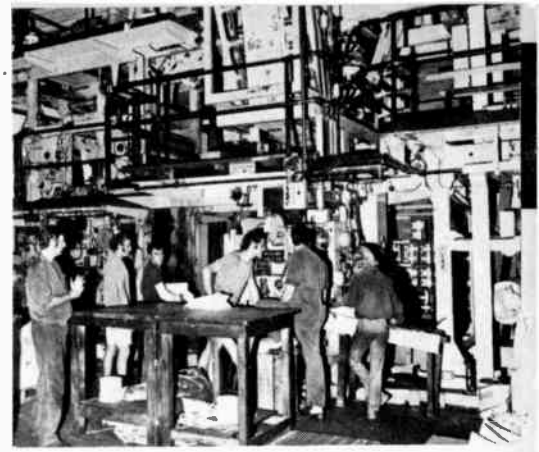
Fig. 5 shows a system using the tacho as the feedback element in the closed loop controlling the armature supply. In addition, a field weakening circuit is shown which extends the motor speed from base to maximum speed as follows:

The armature voltage, again taken as an approximate measure of the motor back-emf, is compared against a fixed dc voltage and the resulting control signal is used to regulate the field supply. However until the armature voltage approaches the base-speed value, the field supply is maintained at maximum; as the back-emf tends to increase further, the field control system operates to reduce the field excitation.

Typical applications of tacho-feedback systems include papermaking machines, component conveyors, packaging machinery, printing presses and winding machinery.

SPEED MATCHING

An advantage of using tacho feedback for the master drive in a multi-drive installation is that the master tacho output can be used as the 'reference' signal for the closed loop systems, thus regulating the speeds of the 'slave' drives. Figure 6 illustrates such a circuit where RV1 enables adjustment of the speed-match between the drives of TG1 and TG2. Speed matching is essential in such an application as printing presses where all motors have to be exactly synchronized in order to prevent tearing the paper.



A large number of individual dc drive motors are speed co-ordinated in the latest version Halley Aller printing press. (This actual press is used to print the Australian edition of Electronics Today International).

CURRENT LIMIT

In certain conditions of acceleration from zero speed, and possible mechanical overload, the armature current has to be limited to a safe value of (typically) 120 to 150% of the rated full-load value. In the typical circuit of Fig. 7, RV1 is used to preset the limiting value of armature current, below which the voltage at R1-R2 junction is sufficiently negative to reverse bias the diode D1. When armature current exceeds the set limit, this voltage becomes sufficiently positive to make D1 conducting and limit the positive output of Q1 until the motor has accelerated and/or the armature current has fallen below the limiting value.

CONTROLLED ACCELERATION AND DECELERATION

In some applications, it is necessary to control the rate of acceleration (or deceleration) of a motor between two set speeds. For this purpose, the usual dc reference voltage is first converted into a ramp form signal by a circuit similar to that in Fig. 8. In the steady-state condition, V_r is equal in value and opposite in polarity to V_x. Any change in V_x (due either to the operation of S1 or rapid changes in the setting of RV1) causes the circuits in SC to generate a step-form voltage of the same polarity as the deviation in V_x; this step change of constant amplitude is integrated by the operational amplifier (A) at a time-constant determined by the

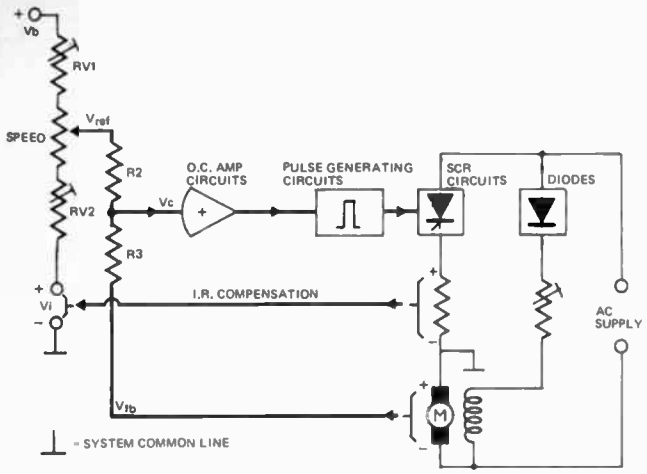


Fig. 4. Armature voltage feedback.

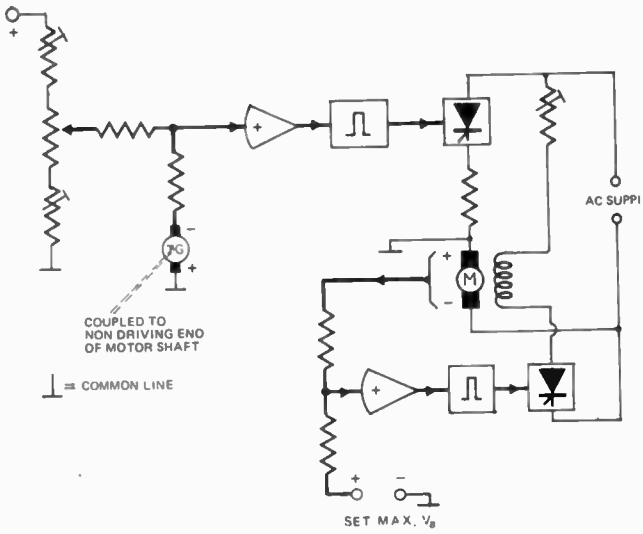


Fig. 5. Tachometer feedback system.

product of R1 and C1, to give a ramp output in the opposite sense. Resistors R2 and R3 serve to limit V_r at a value equal (and opposite) to V_x – at which point, the SC circuit is restored to the quiescent state, stopping any further integration. Fig. 8a shows the relation between V_x and V_r.

Adjustable rates of acceleration/deceleration are possible simply by making R1 variable and independent rates for acceleration and deceleration by switching variable resistors etc.

DYNAMIC BRAKING

To stop a running motor quickly, for example under emergency conditions, its field is switched to (or maintained at) full excitation, and its armature is disconnected from the supply and connected across a suitably rated resistive load. (Fig. 9) the motor now acts as a generator and the rotational energy in its armature is converted into electrical energy which is dissipated in the braking resistor in the form of heat. Braking torque, which is proportional to the motor speed, decreases as the motor slows down; so the final stop is effected either by friction inherent in the drive, or by mechanical braking.

Continued on page 37.

SCR CONTROL CIRCUITS

A typical SCR motor armature supply is shown in the circuit of Fig. 14. If (for the purposes of illustration), the SCRs are considered to be normal diodes, it can be seen that the circuit is a full wave bridge rectifier which provides dc for the motor armature from the single phase ac mains. However the SCRs are *gated* rectifiers, that is they only conduct when the anode is positive with respect to the cathode, and after a trigger pulse has arrived at the gate. Once initiated, conduction will continue for the remainder of the half cycle of mains voltage.

The relative phase of the firing pulse will determine the magnitude of the average current through the motor armature. Note that the firing pulses for SCR1 and SCR2 must be 180° out of phase.

For high power applications a three phase supply is generally used and in this case firing pulses must be 120° apart. A three phase armature supply bridge using SCRs is shown in Fig. 15. Diode D3 in Fig. 14 and D4 in Fig. 15 are commutating diodes which provide current flow paths for the energy stored inductively in the motor armature during supply mains periods when there are no SCRs conducting.

FIRING PULSE CIRCUITS

Fig. 16 shows a simple form of phase control circuit suitable for controlling the SCR bridge circuit of Fig. 14. In this circuit the diodes D1 to D4 supply full wave rectified waveform which is clipped at approximately 20 volts by zener diode ZD1. Thus a stabilized charging voltage is applied to the network RV1 and C1. The voltage on C1 rises until the UJT fires. Current flows through the primary of T1 and out of phase pulses are taken from the secondaries to the two SCRs.

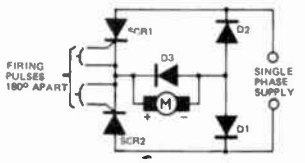


Fig. 14

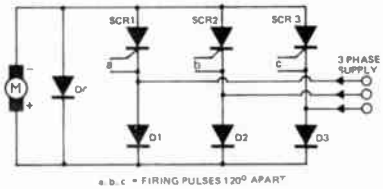


Fig. 15

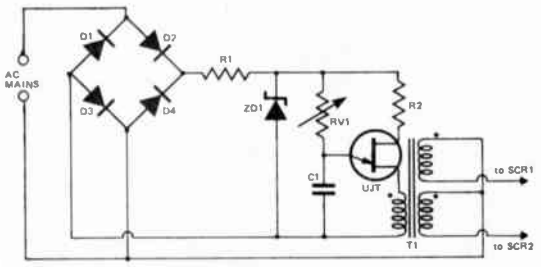


Fig. 16

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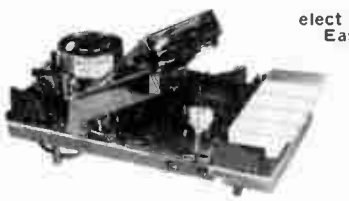

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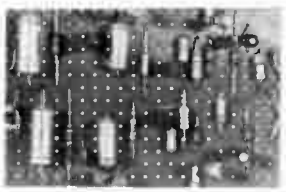

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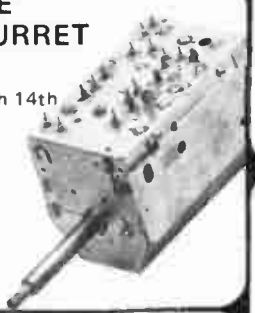

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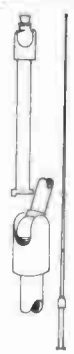

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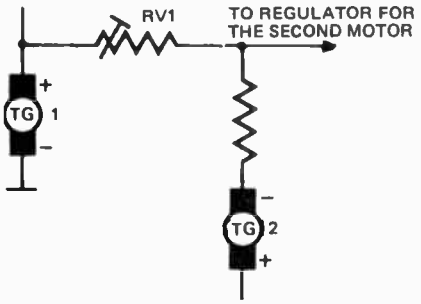

Fig. 6. TG1 is used as master-tacho in multi-drive installation. RV1 enables relative speed between motors to be varied.

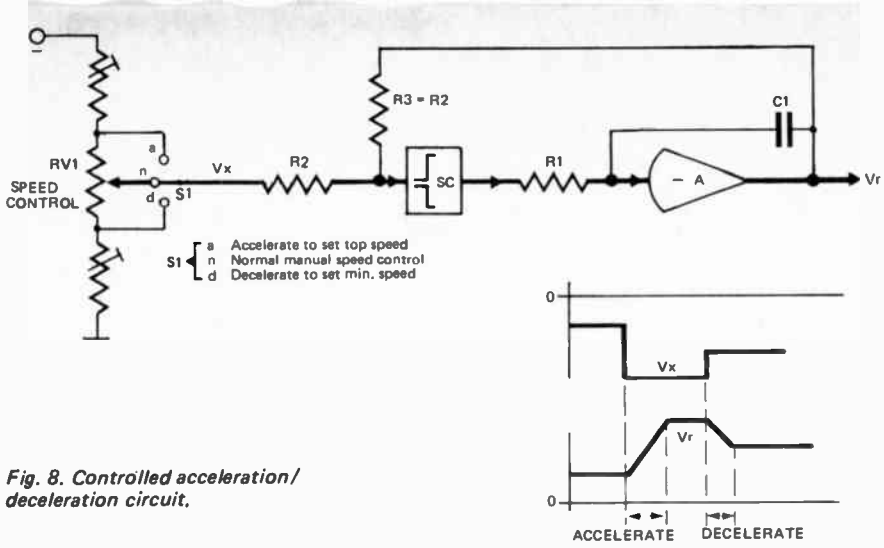

Fig. 8. Controlled acceleration/ deceleration circuit.

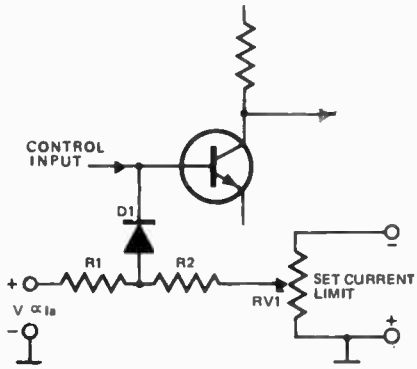

Fig. 7. Current limiting protects motor and/or load.

Another form of braking, known as regenerative braking, is often used to provide controlled reverse-torque in applications where drive speed or material flow tends to 'run away' if not so controlled.

Recently, however, controlled regeneration has been built into thyristor drives to enable braking (or reverse torque) under regulated conditions. For this purpose, it is necessary to incorporate another set of controlled SCR's to regulate the electrical power fed back to the mains supply during regenerative operation.

REVERSAL OF MOTOR ROTATION

The direction of rotation of a dc motor can be reversed by reversing the polarity of either its armature supply or field supply.

Reversal of armature supply, with the field excitation kept at maximum, is (slightly) the more preferred method. As the armature supply is reduced to zero, a voltage-sensitive circuit detects the near-zero condition and operates contactors to reverse the armature connections. This method avoids inductive emfs causing excessive arcing across the contacts which would happen if switching were to be done at high armature votages.

If an associated closed-loop system uses tacho feedback, a circuit similar to the one shown in Fig. 10 is often used to ensure that the polarity of feedback voltage remains the same in either direction of rotation.

Reversal of shunt-field excitation is easier to carry out when this excitation is obtained from a dc generator and will be dealt with later.

REELING DRIVES

A familiar requirement in many industrial drives is the need to process material at constant linear speed through the line, and to wind it on to drums or mandrels. In some applications (e.g., cables, rolled sheets of metals etc). the tension at which the material is wound on to the coiler drum is not so important as that the build-up of material on the drum should be uniform. In such cases, a potentiometer operated by a cantilever arm riding over the reel is used to reduce the speed of the drum-driving motor progressively (relative to the line speed) as the reel builds up.

TENSION/HP REGULATION

In many reeling applications (e.g., paper, fabric, plastic film etc), the material must be both processed through the line and wound on to a drum at constant tension, while simultaneously maintaining a constant linear speed at which the material is taken through the line.

For this requirement, the reeling motor which drives the drum must be operated in the 'constant horsepower' mode, and is usually selected to have a maximum-to-base speed ratio comfortably above the maximum-to-minimum diameter of the drum (maximum diameter corresponding to full build-up of material on the drum and minimum diameter corresponding to an 'empty' drum). For example, a motor with 2000 rpm max speed and 400 rpm base speed would be used to drive a 1ft diameter empty drum to a 5ft diameter build-up, the motor speed reducing as the reel builds up.

Figure 11 shows a typical arrangement where the armature voltage supply is regulated by a closed-loop system – comparing the line-speed reference voltage against a line-speed tacho output. To control the field excitation and maintain I_a constant (for constant horsepower operation), a voltage proportional to I_a is compared, in a second closed-loop system, against a 'Set Tension' reference voltage from a manual (or auto-set) potentiometer, or from suitable tension transducer devices. Since V and I_a are kept constant, the second system operates to increase the field supply as the reel builds up, thus reducing the motor speed also proportionately.

WARD-LEONARD SYSTEMS

These are often preferred in multi-motor drive installations, especially when the application requires one or more motors to regenerate. A familiar example of regeneration is a paper uncoiling drive in a printing plant where the paper is reeled off the bulk-roll and pulled through the printing rolls at constant speed and tension; the motor controlling the reel-off drum does not drive the drum but exerts a regulated braking torque to the pay-off rolls. The voltage supply V to its armature is less than the back-emf E generated in its armature (due to the motor rotational speed N and its field flux Φ)

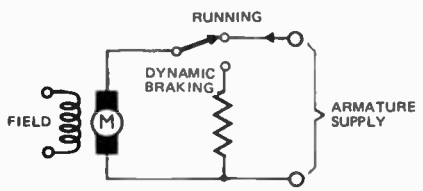

Fig. 9 Dynamic braking – resistor is switched across motor armature.

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$29.64 $1.50 p&p.

TANGENT KITSETS

2 Transistor Radio kit. A most popular kit at a most reasonable price — requires no aerial, complete with "easy to build" instructions — all you require is a soldering iron. Ours took only 30 mins to build. Pre-wound aerial coil and crystal earpiece supplied or can be used with any small amplifier (such as below) to operate a speaker — $5.70 plus battery 53c.

AMPLIFIER KIT

A 4.5 watt RMS (6 watts peak) amplifier, features excellent fidelity and extremely low distortion (less than .5% at 1 watt), easy to build. Supplied complete with comprehensive instructions. Suggested uses are—
(1) Stereo amp
(2) Baby alarm
(3) Amp for 2 tran. radio
(4) Intercom
(5) Thing-a-me-bob.
Requires approx. 12 to 18 volts DC.
AMP KIT — $8.70 incl. P.&P.
Fully built & tested: $9.50.

Power supply for above — pre-built, will operate two of above amplifiers or useful for many other things, 240v to 13.8 volt D.C. at 1 amp — $9.00
CALL IN AND SEE THESE UNITS OPERATING.

CIRCUIT BOARDS — pre-tinned

The "Rolls Royce" of circuit boards are now available from Dick Smith — give your equipment that professional look — all boards are heavy duty and are fully pre-tinned to prevent oxidation marks and to make soldering easier.

71	C12	Musicolor Mark 2	3.00
72	SA1	Economical Amplifier	3.00
72	R2	Crystal Locked Receiver	1.60
72	P3	Microphone Pre-Amp	.90
72	T3	EA130 Tuneable I.F.	3.20
72	PS6	Reg. power supply	.98
72	C2	Sync. & pattern gen.	4.75
72	A6	P.A. Amp	1.50
72	MX6	P.A. Amp	2.70
72	P2	Mic. preamp.	1.60
72	C8	6 Metre Converter	1.30
72	G7	Guitar Amp.	1.50
72	SA9	Amplifier	1.50
72	S10	Scaler	1.60
72	10	IC Probe	.95
72	S11	4 Channel Converter	1.50
72	SA10	Playmaster 136	1.90
ET025		Super Stereo	1.90
ET026		Tape Slide Sync.	1.50
ET029		Tuner	1.45
		IC Power Supply	2.50
ET033		Int. audio system	2.60
ET034		Int. audio system	2.60
ET111		Power Supply	1.50
ET1413		100W AMP	2.20

HI-FI SOUND ROOM

We have our sound room now operating on the second floor — demo's of Pioneer, Teac, Hitachi, AWA, Philips Sound systems — also see and hear operating constructional projects including musicolour, quad unit, 100w AMP, Playmaster etc.

SUPER KITS

Dick Smith "Super Kits" are very special as they have been selected by him for "V.I.P" treatment. At lease one of each kit has been ouilt by Dick Smith or his staff and is on display at the electronics centre. Other features are:

1. Expensive pre-tinned "silver" boards.
2. Full copies of constructional articles included.
3. Any changes in circuits, addendums etc are included — saves checking following issues.
4. Most kits contain "extras" at no cost. These extras have been added where Dick Smith thinks they maybe more reliable or where he feels the constructor may have difficulty in purchasing them.

REMEMBER if Dick Smith can build it — anyone can! ! !

MUSICOLOUR MK II (E.A. DEC. '71). Build this exciting colour organ unit. It may be driven from any low level output from your amplifier or radio unit and will operate up to 1000 watts per channel. Complete kit including full instructions and heavy duty (10amp) triacs $49.50 P&P $1.00.

CDI KIT (E.A. AUG. '70)
Want to improve the performance of your car? Then make up this well proven capacitor discharge ignition unit. Supplied complete with instructions. **Extra at no cost:** Pre-wound secondary coil and special silicon grease $21.00 P&P $1.00

100 Watt AMP (E.T. DEC. '72)
The complete kit to build this enormously powerful quality amp. Extra's include deluxe pre-tinned circuit board, silicon grease, a can of heat absorbing spray paint and full construction details. New Low price $65.00 p&p $1.00.

SEPARATE PARTS FOR ABOVE KIT:
Metalwork including pre-drilled heat sinks $14.50 P&P 50c
PF 3577 transformer $10.60 P&P $1.50
ET.1413 circuit board $2.20

STEREO 24 ADAPTOR (E.A. Nov. '72)
We have recently built this inexpensive unit and find it quite amazing (call in and have a listen if you can). Complete kit including special board and instructions $5.75 P&P 50c.

PLAYMASTER 136 AMP (E.A. DEC '72)
Good value for money with special transistor offer from Fairchild. Complete kit (less "special offer" transistors) including attractive front panel, pre-tinned boards and silicon grease for transistor mounting. 26 watts RMS Output
$55.60 P&P $1.00
Metalwork only $8.00 P&P 50c
Panel only $2.50
Board 72 SA10 $1.90

Call in and see these completed "Super kits" and always remember if Dick Smith can build it — ANYONE CAN! !

SIGNETICS LINEAR TIMER I.C.

This hard to obtain "IC" is now available ex-stock Price $2.38 + 20c P&P.

TEST EQUIPMENT SPECIALS

UNIVERSAL SIGNAL INJECTOR MODELS DSE-260

For easy servicing of all radio, TV, amplifiers, tape equipment etc. This fully transistorised unit has a signal output from audio through to HF frequencies — a must for all servicemen — will pay for itself quickly in saved labour. Complete including 1.5 volt battery.
$7.80 P&P 30c

JAYEM MODEL L—55 FET MULTITESTER

This amazing instrument features a 20 Meg ohm input impedance, 36 ranges from 300 mV full scale to 1200 volts and can measure as low as .2 ohm! Comes complete with probes and carry case. (Full technical literature available).
Limited quantity only.
$43.20 incl. p&p.

DIODE SPECIAL

Motorola MR 75 power diodes at extremely low prices (bulk purchase) current rating 6 amps continuous, 10 amps in bridge configuration, 22 amps continuous if mounted on a heat sink and a colossal 400 amps surge!
MR 751 (100V P.I.V.) 4 for $3.20
MR 754 (400V P.I.V.) 4 for $4.80
MR 756 (600V P.I.V.) 4 for $6.00 p&p 30c per order.

MR751

SPECIALS
Build yourself a motor speed controller for bench drills, electric motors etc, full 750 watt rating.

KIT D.S.E. 1 includes 10 amp S.C.R., Pot, Diodes and simple circuit $5.75.

KIT DSE-12 includes above and hardware (metal box, power connectors etc) to make complete drill speed controller $9.75 (P&P 30c)

Philips high quality carbon ¼ and ½ watt resistors 4c each or $3.00 per 100.
BC108 transistors: 10 for $3.00.
2N3055 transistors: 10 for $13.00.

GO SOLID STATE

VHF POWER TRANSISTORS 30 watts at 12.6 volts — FANTASTIC OFFER TO AMATEURS — $9.85.
These transistors manufactured by "Solid State Scientific" are exactly as currently being used by Australia's largest VHF mobile radio manufacturers. They are virtually indestructible (they withstand severe V.S.W.R.) and are guaranteed to give in excess of 30 watts at 144 mcs on 12.6 volts (more at 13.8 volts!) Supplied complete with data sheet, test, circuit and layout diagram.

FEATURES:
- Withstand severe V.S.W.R.
- Low inductance stripline package.
- All leads electrically isolated from stud.
- Greater than 4.4 db power gain

TYPE 2N 5591-$9.85 plus 50c p&p.

DRIVER TRANSISTORS AVAILABLE.
Complete with data sheet and suggested circuit and layout diagram.
2N 5590 (15 watts) $7.75
2N 5589 (7 watts) $6.50 p&p 50c
The complete set of three transistors are available as a special package offer for $22.50 plus p&p 50c.
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AMATEURS — SEE YOU AT THE GOSFORD FIELD DAY

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LESS THAN WHOLESALE

APAN model BMU 121 features a 12" cast (weight 4lbs) turntable plate, hydraulic cueing device, 2 speeds, fully adjustable tracking weight with counter balanced arm, 4 pole induction motor, auto stop high quality magnetic cartridge with diamond stylus — $69.00 p&p $3.00
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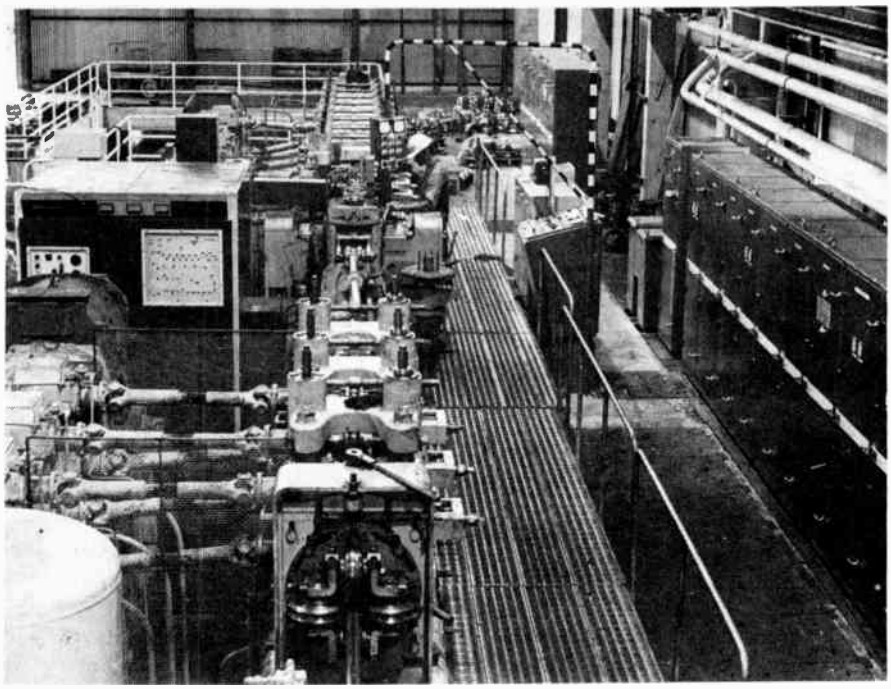
VARIABLE SPEED DC DRIVES

plus the I_aR_a drop in its armature. Such a condition always occurs when a motor is mechanically driven at a faster speed than the speed corresponding to the voltage supplied to its armature and field, thus the motor is forced to operate as a generator.

In a Ward-Leonard system, the armature supply to the motor is obtained from a dc generator driven at constant speed by an ac motor. Regulation of this supply is by closed-loop control of the generator's field excitation, as shown in Fig. 12. Slave motors, also connected across the generator output, are speed-matched by various means ranging from simple rheostats (in the armature or field circuit as necessary) to boost/buck generators in series with their armatures.



General view of the forming, welding and sizing sections at New Zealand Steel's new commercial pipe plant at Glenbrook. On the right are cubicles housing Thorn Automation drive systems controlling the continuous production line.

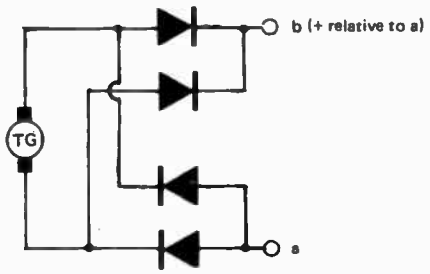


Fig. 10. This circuit is used to ensure correct polarity from tacho generator.

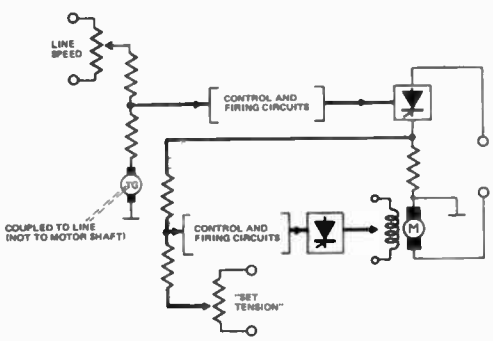


Fig. 11. Typical 'controlled tension' drive.

In reel-off applications, a voltage proportional to the regenerative (i.e., flowing from the motor to the generator) armature current is compared against a set reel-off tension reference, and used to control the generator field such that the correct relationship is maintained between the back-emf in the motor and the generator output voltage. For braking purposes, the Ward-Leonard system is practically ideal since the generator armature serves as the regenerative load for the motor and the generator output can be reversed to assist stopping the motor quickly.

An interesting advantage of Ward-Leonard systems, especially in the lower power applications such as milling machines, is the ease with which the motor can be reversed smoothly and without the need for switching in the armature circuit. Dc generators for such applications are provided with a split-field winding (Fig. 13) controlled by a form of 'push-pull' circuit. By controlling the relative excitation of each half of the winding, the generator output polarity (hence the direction of controlled motor rotation) and value (hence the speed of the controlled motor) can be smoothly varied from one extreme to the other.

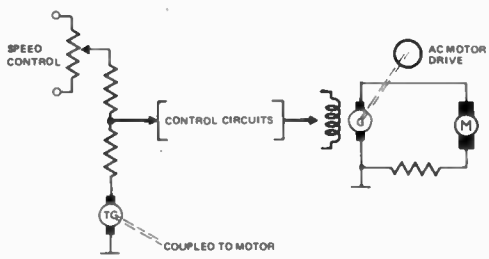


Fig. 12. Ward-Leonard control.

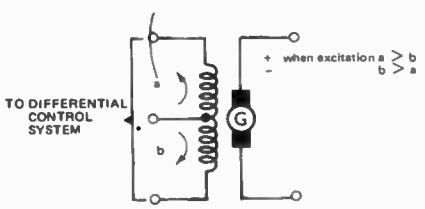


Fig. 13. How Ward-Leonard systems may be reversed.

CONCLUSION

In recent years many attempts have been made to develop electronic control systems for ac motors and thus take advantage of the lower cost and maintenance of such motors. However, as yet such systems have not been able completely to replace the simple and versatile dc motor with solid state and closed loop control. It seems likely that dc drives will remain a viable source of controlled motive power in industry for many years to come. ●

VOCOM-an entirely new concept in communications

A Pandora's box of electronics, this unit can theoretically produce all possible sounds.

ELTRO 'Tempophon' – Magnetic tape time/frequency compression system.

For effective use to be possible, an essential property of any communications system is an output that is consistent with that system's input. The basic information must not be confused or distorted by the system. And while not essential, a very desirable asset is a quality of output signal comparable with the input signal.

The telephone, probably the most basic of electronic communication systems, is an analog device – the amplitude and frequency of impulses acting upon the receiving earpiece bear a direct relationship to the air-pressure variations impinging upon the associated microphone diaphragm. It is self-evident that the telephone has certain technical shortcomings, only two of which need concern us here – a low signal-to-noise ratio, the "poor line" we occasionally find ourselves battling against and which impairs the intelligibility of transmitted information, and a second and more basic drawback which is that of inefficiency – only a very small quantity of information can be handled on one telephone line.

When a large volume of information has to be transmitted "long-hand", satellite links and undersea cables incur large expense. Naturally, under these circumstances, the greater the density of the transmitted data, the more economical will be the system in use.

For many years communications' engineers have researched possible methods of squeezing more information into less time.

This research has followed four paths – Time/Frequency Compression, Assignment Speech Interpolation, Coarse Amplitude Quantization and Voice Analog Vocoders.

TIME FREQUENCY COMPRESSION

Time/frequency compression can be accomplished with magnetic tape devices incorporating rotating heads; intermittent sampling of the signal is carried out and the sampled periods "joined up". The periods when "stretched" in this way, give a proportionally reduced frequency bandwidth and consequently a narrower channel requirement. The system, with its finely balanced mechanics, is bulky and so far experiments have indicated that a marked limitation exists; intelligibility is seriously imaired before a reasonable bandwidth saving can be achieved.

Recently the scope of integrated circuit technology has enabled the production of a solid-state device which, when used in conjunction with a tape replay mechanism, allows variable-speed constant-pitch reproduction. This analog device, marketed by an American firm Cambridge Research and Development, will allow blind users of "talking book" services to adjust the replay speed to suit their capacity for information intake – devoid of annoying "chipmunk" effects.

ASSIGNMENT SPEECH INTERPOLATION

The method termed assignment speech interpolation can increase data handling efficiency by up to 300%. This system is used in conjunction with some sort of multi-channel installation; its principle relies on the expedient of filling natural pauses in one person's speech with syllables from the conversation of another's.

COARSE AMPLITUDE QUANTIZATION

In coarse amplitude quantization, the speech waveform is converted to a clipped square wave and although the result is rasping in quality, it still manages to retain good intelligibility. The system is cheap and not as yet fully exploited, despite the potential of bandwidth economy in excess of 200%.

VOICE ANALOG VOCODERS

An interesting, mainly experimental group is that of the Voice Analog Vocoders. These devices analyse speech into its constituent frequency bands and relate these patterns to the physiological position of the speaker's vocal cords, lips and tongue. During coding, unnecessary information is discarded, and the condensed information fed to a store/receiving terminal. The speech is reproduced using imitative circuits analogous to the physiology that produced the speech originally.

At present much work is in progress in this field which shows promise of providing up to 1000% bandwidth savings. However it *is* an analog system and requires a large volume of circuitry and, of necessity, an analog-to-digital converter in association with a digital computer.

VOCOM

Now, in England, a unique new system has been developed which, in the very near future, could possibly obsolete all the varied techniques just described.

International Voice Movement is the company that has researched and will be marketing the system, which

surprisingly has been developed as a fortunate spin-off by the designers (who up to now have been more familiarly associated with the manufacture of sophisticated electronic musical equipment).

Vocom, short for "voice communication through compression and computation", instead of trying to reproduce a speaker, concentrates on recreating and reproducing sounds.

Speech is fed into the system which then analyses and simplifies it to produce a code corresponding to the frequency patterns or "domains".

Average speech will result in a (simplified) digital coding of around 200 bits/second; telephone lines are capable of carrying data containing up to 60,000 bits/second. Therefore Vocom has a potential to transfer data at 300 times the original speed.

The data is "reconstituted" at the receiving terminal in such a refined manner that not only are the words intelligible but the original speaking voice is recognisable!

To bring this achievement into perspective it should be noted that Vocom is capable of condensing a 30 minute speech to a mere six *seconds!*

HOW DOES VOCOM WORK?

The heart of the system is a bank of sixty-four special devices, each of which can function either as a filter or an oscillator. The devices are switched to the former mode to receive the input signal — this part of the system has been likened to the basilar membrane of the inner ear; each fibre responds maximally to one particular frequency with a sensitivity that gradually falls off to zero at pitches above and below the resonant point. Our brains recognise characteristic sounds and musical pitches by the relative amplitudes of signals from these fibres.

(In fact it is not the *amplitude* that is the variable parameter but the frequency of trigger pulses elicited from each activated fibre — the more violently a fibre is vibrated the greater the frequency of trigger pulses sent to the brain which *interprets* this as different amplitudes of the particular frequency corresponding to the stimulated fibre).

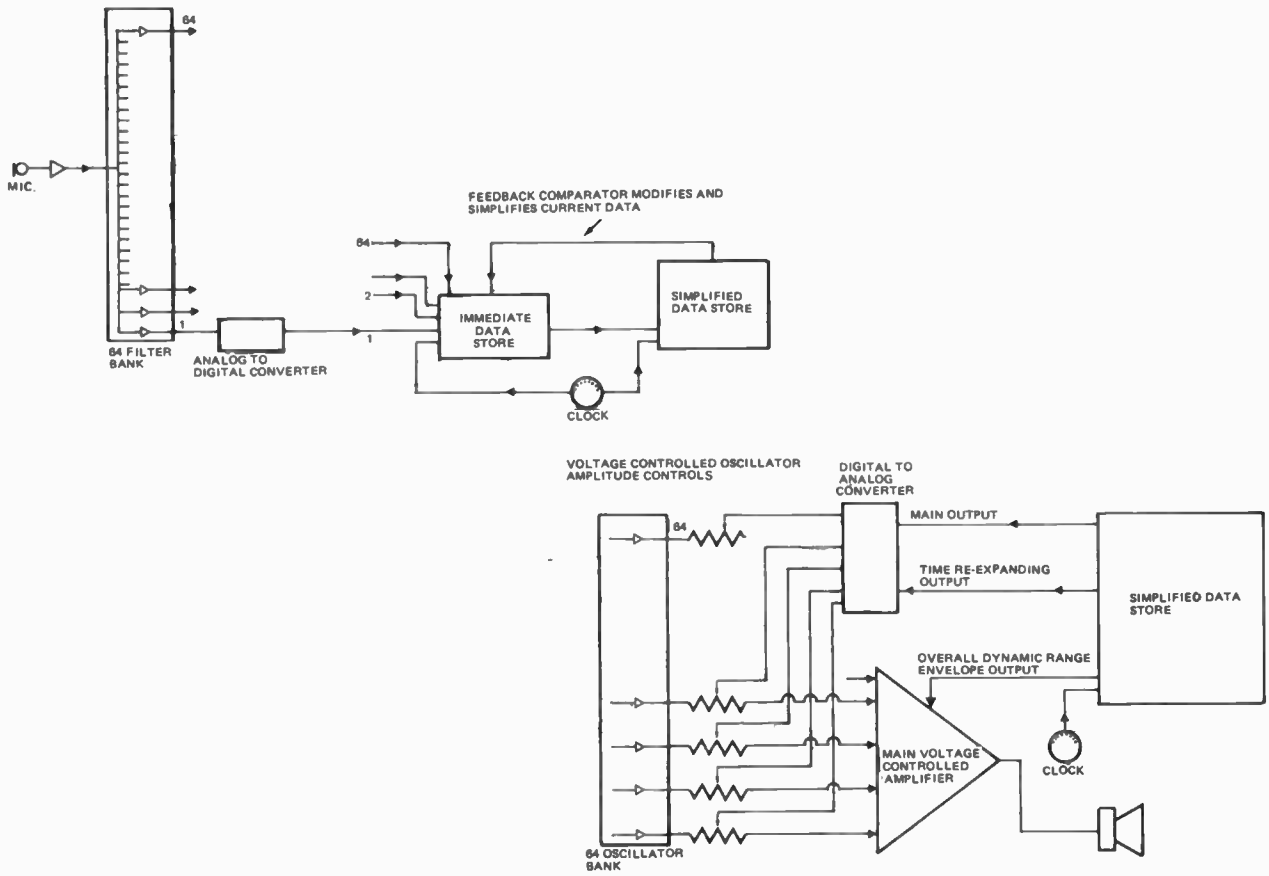
The narrow frequency band that each filter is most responsive to, is also that frequency at which the same device will oscillate when this mode of operation is selected (during "replay").

To understand the system consider one continuous unchanging sound fed to the input. The sound (unless white noise) will have a limited bandwidth, hence some filters will not respond at all, and the rest in varying degrees according to how the energy of the signal is distributed throughout the frequency spectrum. Every filter is simultaneously and regularly sampled at a very high speed. The amplitude of output of a filter at a particular instant of sampling could be any one of an infinite number of values. The designers have (empirically) proved that a 256-level differential between zero signal and maximum signal provides adequate amplitude resolution. An associated computer can, in this way, using 8-bit words, store records of the output amplitude of every filter at each specific sampling interval.

To reproduce the stored information in audio form, the filters are switched to the oscillating mode and the amplitude of each of the 64 outputs controlled by the relevant 8-bit word. It is evident that any sound, however complex, can be analysed and stored.

The fidelity of the "re-synthesised" sound depends on the sampling clock speed — the smaller and more frequently the samples are taken, the greater will be the fidelity of the resultant sound. An analog exists in photography — the finer a film-grain, the higher is the potential definition in a photograph.

In the analysing stage of Vocom the bit rate can sometimes run as high as 1,000,000 bits/second. This figure includes many repetitive items of data. For instance, if a vowel is spoken, the sound may remain of virtually constant amplitude over a 70 ms



Simplified block diagram of VOCOM. TOP: Encoding; BOTTOM: Decoding.

HIGH FIDELITY LOUDSPEAKERS by Richard Allan

YORKS ENGLAND

CONSERVATIVELY RATED, in the best British tradition, Richard Allan loudspeakers incorporate massive ceramic magnets, long voice coil assemblies and a corrugated cambric suspension that ensures linear performance at high power. Magnetic flux is unusually high, being 105,000 maxwells for the 10in units, 186,000 maxwells for the 12in Super models and 220,000 maxwells for the 15in bass speaker . . . you'll be agreeably impressed with their outstanding performance.

SPECIFICATIONS

Size	Type	Function	Freq. Range (Hz.)	Power (Watts) rms (Peak)	Flux Density (Gauss)	Total Flux (Maxwells)	Baffle Hole Dia. in. (mm)	Fixing cts. (p.c.d.) in. (mm)	Overall Depth in. (mm)
15" 2" pole (53mm) 25Hz.	CG15	Bass	20/5,000	20 (40)	17,000	220,000	13¾ (350)	14⅝ (370)	6¼ (159)
HEAVY DUTY 2" POLE (53mm) 15" (381mm) 70-80 HZ 8 ohm	CG15HD	Guitar	60/4,000	30 (60)	17,000	220,000	13¾ (350)	14⅝ (370)	6¼ (159)
12" (305mm)	CG12HD super	Guitar	60/5,000	25 (50)	14,000	186,000	10¾ (273)	11⅝ (294)	4½ (114)
12" (305 mm) 2" pole (53mm) 30Hz. 8 ohm	CG12 Super	Bass	25/5,000	15 (30)	14,000	186,000	10¾ (273	11⅝ (294)	4½ (114)
12" (305 mm) 1½" Pole (38 mm) 30Hz. 8 ohm	CG12	Bass/Mid.	25/9,000	10 (20)	14,000	105,000	10¾ (273	11⅝ (294)	4½ (114)
12" (305 mm) 1½" Pole (38 mm) 30Hz. 8 ohm	CG12T	Full	25/15,000	10 (20)	14,000	105,000	10¾ (273	11⅝ (294)	4½ (114)
10" (254 mm) 1½" Pole (38 mm) 45 Hz. 8 ohm	CG10	Bass/Mid.	40/10,000	10 (20)	14,000	105,000	9⅛ (232)	9⅝ (245)	3⅝ (92)
10" (254 mm) 1½" Pole (38 mm) 45 Hz. 8 ohm	CG10T	Full	40/15,000	10 (20)	14,000	105,000	9⅛ (232)	9⅝ (245)	3⅝ (92)
8" (203 mm) 1" Pole (25.4 mm) 55Hz. 8 ohm	CG8	Bass/Mid.	45/10,000	6 (12)	14,000	56,000	7 (178)	7⅝ (194)	3⅝ (92)
8" (203 mm) 1" Pole (25.4 mm) 55Hz. 8 ohm	CG8T	Full	45/17,000	6 (12)	14,000	56,000	7 (178)	7⅝ (194)	3⅝ (92)
8" (203 mm) 1" Pole (25.4 mm) 55Hz. 8 ohm	CB8	Bass/Mid.	45/10,000	5 (10)	12,000	48,000	7 (178)	7⅝ (194)	3⅛ (80)
8" (203 mm) 1" Pole (25.4 mm) 55Hz. 8 ohm	CB8T	Full	45/15,000	5 (10)	12,000	48,000	7 (178)	7⅝ (194)	3⅛ (80)
8" 1" Pole	CF8	Bass/Mid.	20/8,000	6 (12)	14,000	56,000	7 (178)	7⅝ (194)	4" (107)
4" (107 mm) ⅞" Pole (14.3mm) 8 ohm	CB4	Treble	2,500	3(6)	10,000	15,000	3⅝ (92)	4¾ (121)	1⅞ (48)
4" (107 mm) ⅞" Pole (14.3mm) 8 ohm	460TC	Treble	17,000	3(6)	6,000	9,000	3⅝ (92)	4¾ (121)	2⅛ (54)
CROSSOVER NETWORKS	CN1284	3-way constant resistance, ½ section, crossover frequencies 1100 Hz, and 5,000 Hz.							
	CN104	2-way constant resistance, ½ section, crossover frequencies 5,000 Hz.							
	CN54	2-way constant resistance, ¼ section, crossover frequencies 5,000 Hz.							

VOCOM-an entirely new concept in communications

period. To reduce the bit rate, Vocom, during its high speed sampling carries out instantaneous comparisons between the code being (at that moment) fed to the computer memory and the codes being stored from the sampling periods immediately past.

Thus the vowel in our example may activate three particular filters at the same individual levels over the 70 ms period. Vocom will recognise this fact and instead of storing a series of, say, ten commands (meaning samples would have occurred every 7 ms) to set the levels at x, y and z amplitudes, it will store only one command to set the levels at x, y and z and a further instruction to the three oscillators to "remain at x, y, z amplitude for the ten sample periods."

Extensive use has been made of large scale integration technology to give Vocom this "commonsense".

As well as the eight bits that control amplitude, eight more bits are incorporated to define the rate of frequency or amplitude change and a further six bits control three output amplifiers, to supervise the overall dynamic level, forming the "vocal envelope".

More bit-saving is possible with Vocom's prepared phoeneme generators; certain consonants, once identified, lead the computer to label them with special digital codes. When, during the "re-synthesis" phase, the same digital command appears, the relevant phoeneme generator will be activated.

The 64 filter/oscillators need not necessarily remain spaced over the complete audio spectrum – by allowing the devices to be concentrated over a smaller area when required, any degree of fidelity is possible. The closer the filters are together the more accurate is the re-synthesis over the frequency bandwidth covered.

So far we have discussed the intake of speech and simplification of data. Once the data is in the computer there are innumerable handling possibilities. Mention has already been made of the 1 to 300 possible compression ratio.

Where secrecy is paramount though telephone lines convenient (military applications?), automatic vocal coding and decoding can be effected. Furthermore programming can regularly and automatically change the code number dialled to make the Vocom link and continuously alter the coding/decoding "cipher".

The computer can store whole vocabularies to act as a telephone answering service with a message capable of being easily updated. The user will be able to modify the information from any telephone and in its "message-taking" capacity *any* length of message can be handled.

The service will not only be useful to large businesses but to any member of the public with a telephone. The only hardware necessary is the Vocom terminal, a small box about the size of a small cassette recorder that is stood beside the telephone. The subscriber just dials numbers on his terminal and the reply comes back as ordinary speech through the telephone earpiece or a small ancillary loudspeaker. The terminal should cost no more than about twenty five dollars although the designers visualise it being rented as part of a Vocom service. A directory would be given detailing codes to link the subscriber into the various services; this would obviously not cover the special confidential codes like the "cypher-system" described above.

Vocom, being computer-linked, can carry out rapid calculations with the bonus of being able to voice the result.

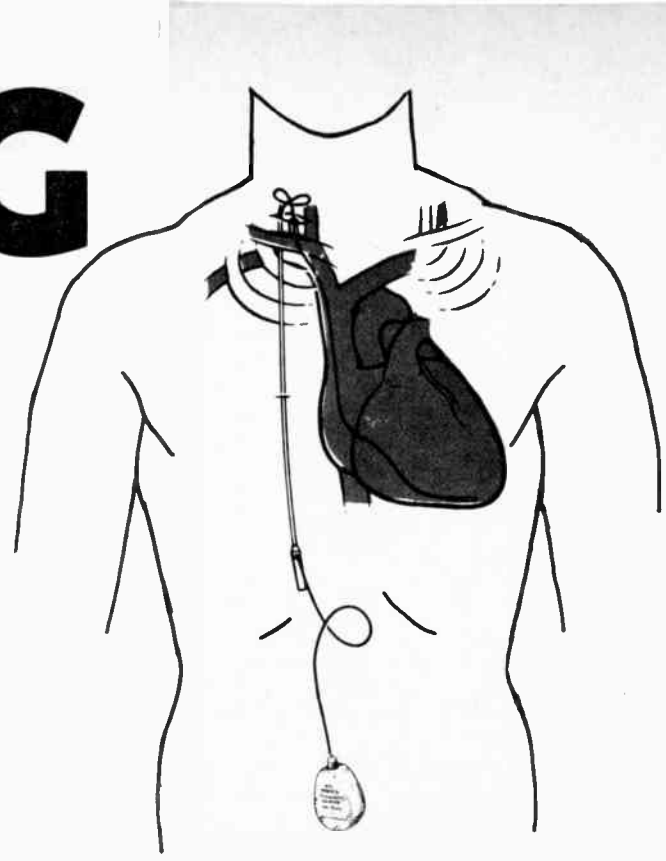
Used as an inventory control system, receiving input data keyed from the stockroom, it can calculate how much stock remains and maintain accurate Vocom listings. A salesman on the road at any time can 'phone in to be "told" the latest stock situation. The speech that he hears will have come from Vocom's vocabulary bank after computerized assessment – no human will have actually spoken the formation of words that advises the salesman. If security isn't a major consideration it is quite feasible for the salesman to use an ordinary telephone number to link him to Vocom.

The stock market reports, rail and air travel announcements and advance bookings all afford opportunities for Vocom to decrease workload and increase efficiency.

In research it permits fine analysis of sound of incredible potential resolution. Vocom in sound synthesis is literally a Pandora's box – without limit. Theoretically capable of producing any and every sound and even of understanding vocal patterns.

One point worth pondering over – a computer with the capacity to hold an intelligent conversation need no longer be a figment of some science-fiction writer's imagination! ●

SETTING THE PACE



Latest heart pacemaker can be checked in-situ with simple equipment — Brian Chapman reports.

Typical cardiac pacemaker implantation. Note that the trigger electrode is inserted into the heart via the jugular vein.

Heart disease is one of the most common causes of death and is the subject of considerable world-wide research. Part of this research is devoted to evolving long-lasting and ever more reliable implantable pacemakers. These devices and their associated electrodes are surgically implanted to assist, or completely replace, the naturally generated electrical signal which controls the heart's pumping action.

Many new types of pacemaker are on the market and before describing some of these we will briefly describe the cardiac (heart) system so that pacemaker terminology may be better understood.

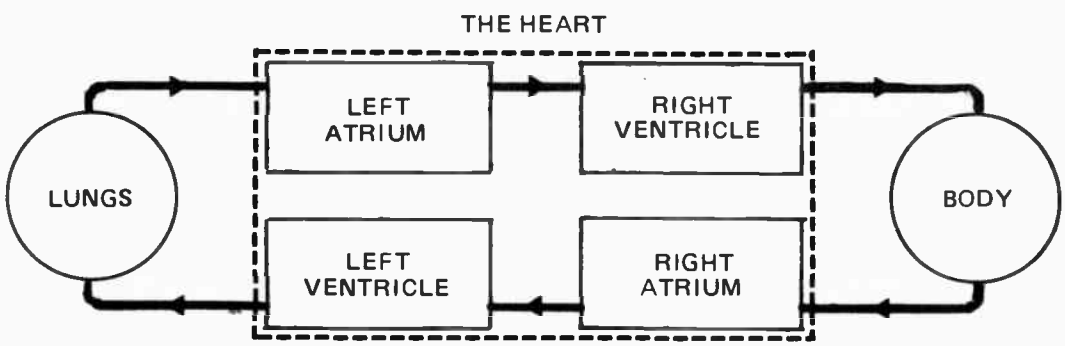
THE BIOLOGICAL PUMP

The heart is an electrically triggered pumping mechanism for forcing blood through the circulatory system. Its action may be understood by reference to Fig. 1, where it can be seen to consist of four chambers. Two of the chambers, known as *auricles* or *atria* receive the incoming blood and the other two chambers known as *ventricles* expel the blood from the heart. Each atrium is connected via a one-way valve to its associated ventricle. The right ventricle pumps blood to the lungs where it picks up a fresh supply of oxygen and this oxygenated blood then goes to the left atrium. After passing through the valve to the left ventricle, the oxygenated blood is pumped into the circulatory system where it distributes oxygen to the tissues of the body. The de-oxygenated blood then returns to the right atrium, passes to the right ventricle, and is pumped back to the lungs for replenishment.

The pumping action of the heart is triggered by electrical signals, generated within the heart itself, causing the muscles of the heart rhythmically to contract and then relax. During relaxation the chambers fill with blood and then, when the muscles contract, the blood is forced out into the circulatory system.

The electrical activity of the heart is

Fig. 1 The circulatory system of heart, lungs and body.



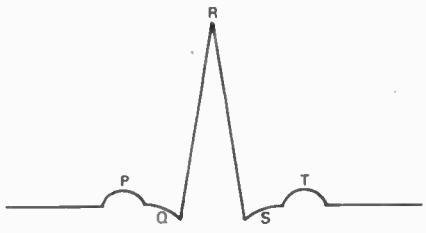


Fig. 2 Typical electrocardiogram waveshape showing letter designations used for various sections of the wave.

thus the primary pumping motivation. This activity may be detected by electrodes placed on the surface of the body. The signals thus picked up are amplified and then used to produce a recording known as an electrocardiogram. Figure 2 shows a typical heart waveform as seen on an electrocardiogram. The various components of this wave are firstly the P-wave which occurs during the muscular contraction of the atria, then the QRS pulse which corresponds to ventricle contraction, and lastly, the T-wave which occurs when the ventricle muscles relax.

TYPES OF PACEMAKER

Pacemaker research is continuing on three specific requirements.

(a) more reliable components and circuits
(b) longer life, built-in power sources
(c) improved clinical performance and testing facilities.

In general, the components used have now been developed to a level where their life exceeds that of the power supply and additionally, work is in progress on nuclear power sources aimed at providing an implantable life in excess of 10 years. See Nuclear Heart Pacemaker ELECTRONICS TODAY INTERNATIONAL, October 1972.

Improved performance has been achieved by developing pacemaker types specifically for certain classes of heart malfunction and by building in test facilities. There are four basic types of pacemaker which can be combined with various electrode systems to suit each respective patient. These are:—

1) FIXED RATE — this pacemaker is suited for patients requiring a slow, continuous, basic rhythm and where there is no tendency to interference from impulses generated by the patient's own heart.
2) VENTRICLE TRIGGERED (RS synchronous or QRS inhibited) — this pacemaker covers the largest area of application and can be advantageously used for patients who display normal heart activity. In the QRS synchronous type, the pacemaker generates impulses which synchronize with the patient's R-wave (and hence do not affect normal action) as long as the heart beat rate exceeds 60 imp/min. When the beat rate falls below 60 imp/min, the pacemaker generates impulses at a fixed rate of 60 imp/min. The basic rate of the pacemaker is adjustable to suit individual requirements.
3) QRS INHIBITED — same as that above except that is inactive until the beat rate falls below the present level, it then generates fixed rate impulses until the natural basic rate is restored.
4) ATRIUM TRIGGERED — this type of pacemaker is synchronized by the P-wave and after a short delay, generates an impulse which triggers the ventricle by means of an electrode implanted within it.

THE VARIOPACEMAKER

A company very active in research and development of pacemakers is Medical Applications Pty. Ltd., a joint venture of Philip Industries Holdings Limited of Australia and Siemens A.G. of West Germany. They manufacture units covering the full range of applications as detailed above and in addition, have

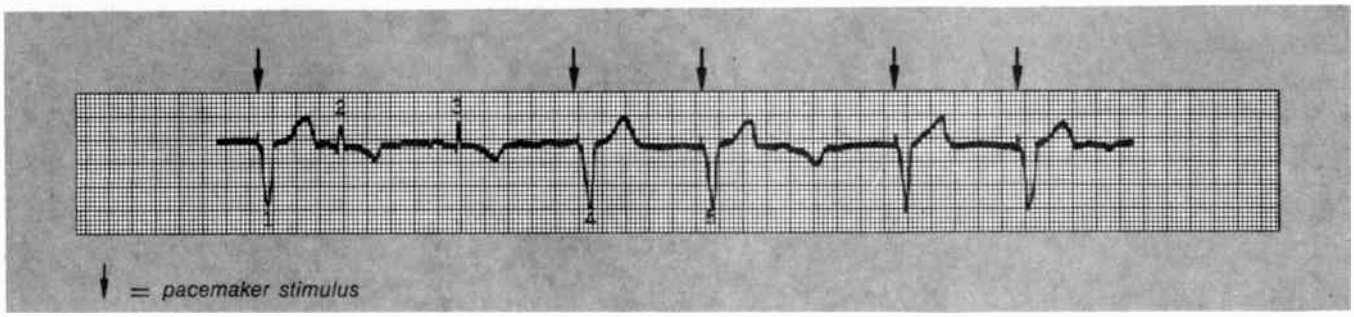


Fig. 3 Actual Electrocardiogram of patient fitted with QRS inhibited pacemaker. Patient's own heart pulses can be seen at (2) and (3) which each suppress pacemaker's output for 1000 milliseconds. After further 1000 milliseconds patients' own pulse is missing so pacemaker induces pulse (4). This operation is also called 'Demand' mode.

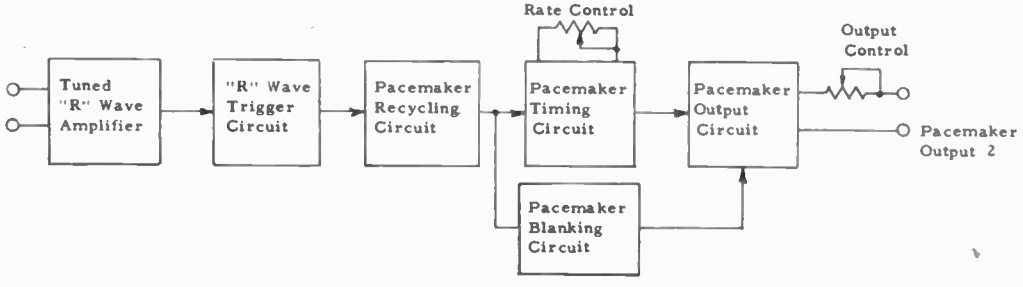


Fig. 4 Block diagram of a QRS inhibited pacemaker, (external) shows the method of suppressing pacemaker output whilst patient's own pulses are present.

SETTING THE PACE

recently added the *Variopacemaker* to their range.

As the success of electrical pacing of the heart greatly depends on the stimulation threshold of the electrode by which the impulses are transmitted to the heart, it is important that this parameter can be readily measured and if need be, corrected before any changes in threshold cause medical difficulties. This is now possible with the Vario pacemaker.

The unit is basically a QRS inhibited pacemaker and normally operates in the manner previously described. The main difference is that a vario function has been added. The vario function is activated by a small bar-magnet which is placed on the skin above the implanted pacemaker. The magnet activates a reed switch and the pacemaker automatically switches to a control frequency of 100 impulses per minute and lowers the impulse amplitude in sixteen equal steps until the sixteenth pulse reaches zero. The unit then returns to full amplitude and commences another step-down series. This process is repeated until the magnet is removed (See Fig. 5).

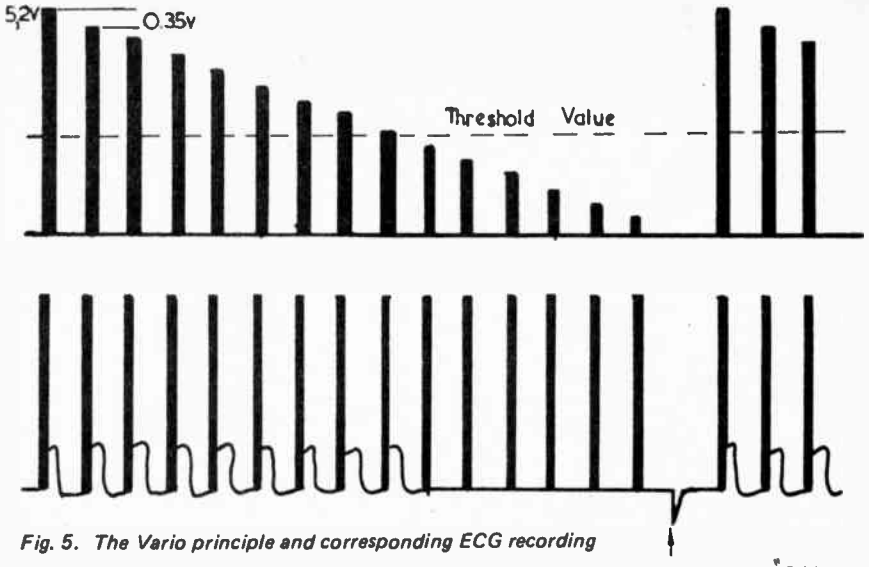
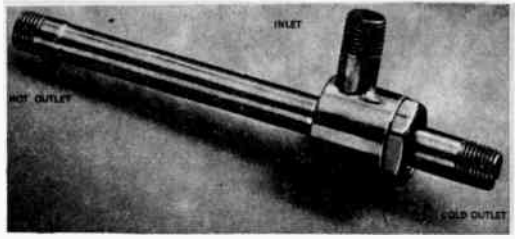


Fig. 5. The Vario principle and corresponding ECG recording

This means that the whole pacemaker/electrode system can be checked without the use of complex electronic test methods and equipment. Any changes in threshold due to electrode integrity are thus detected well before any medical symptoms arise. It would seem that this new technique offers another worthwhile step towards pacemakers having lifetimes exceeding that of the patient. ●



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An interesting and economical alternative to refrigeration is now available to premises with a compressed air supply.

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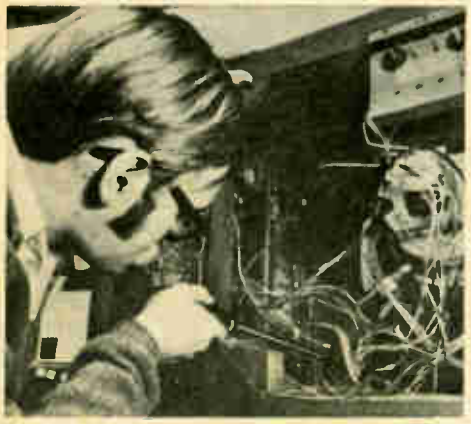

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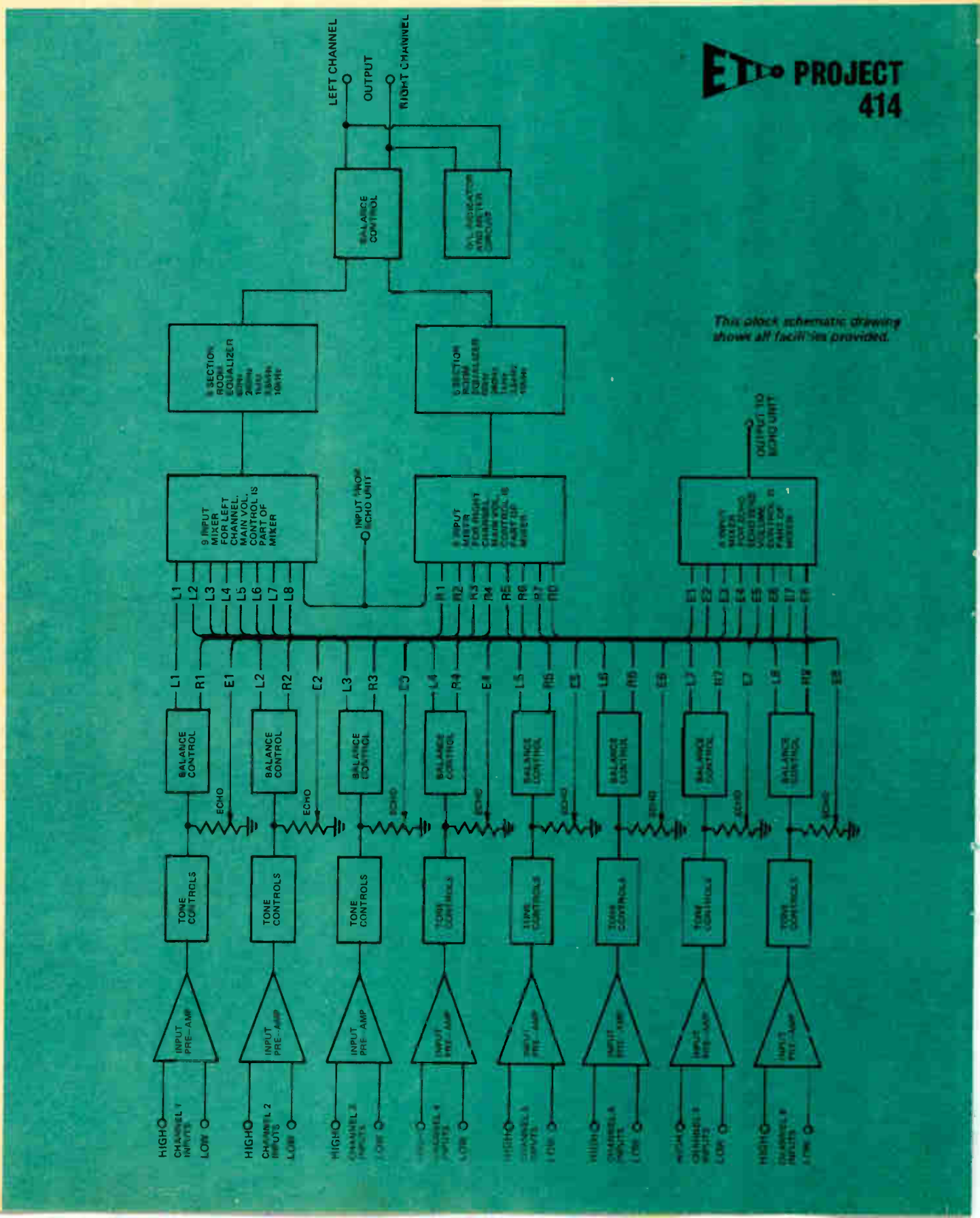
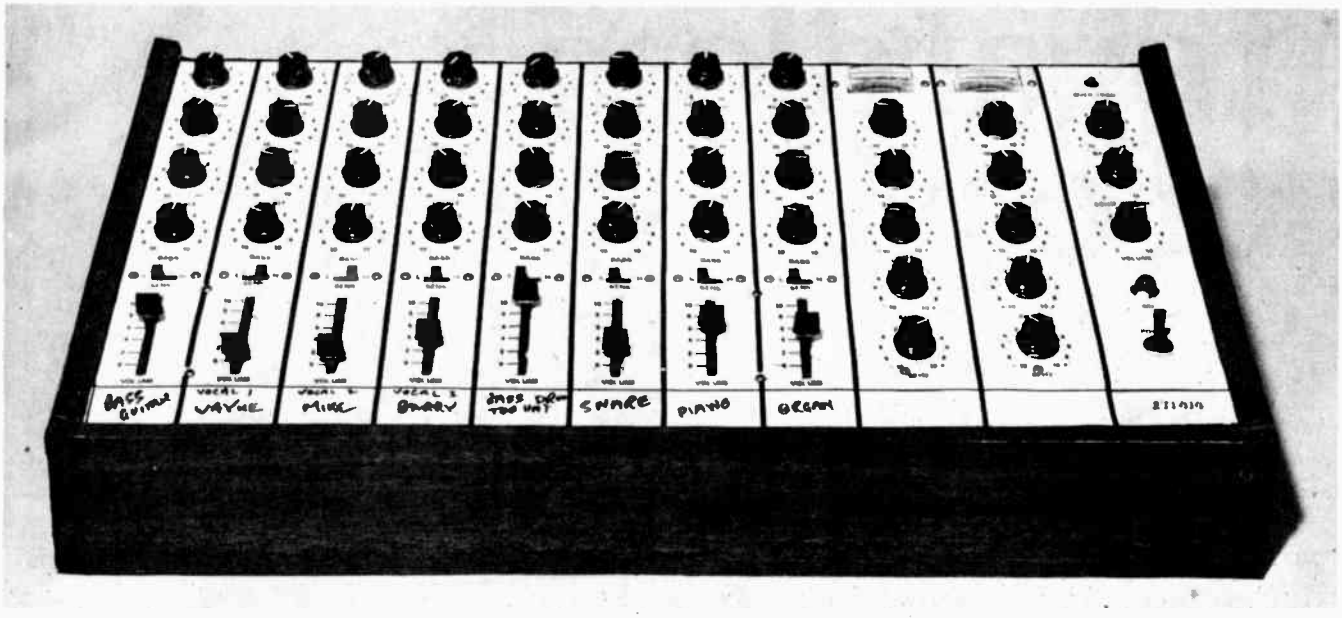


This block schematic drawing shows all facilities provided.

MIXER

Versatile multi-input mixer/preamplifier has all the facilities required for professional PA use.



- **Multiple inputs**
- **Low noise**
- **Stereo outputs**
- **Inbuilt equalizers**
- **Echo facilities**
- **Professional design**
- **Overload immunity**
- **Stage monitor facility**

Anyone who is associated with a pop group or band, will be familiar with the steps one must take to ensure optimum sound in varied localities and halls.

Outdoors, each amplifier and/or public address system must be adjusted separately to ensure sufficient sound and optimum overall mix.

Indoors, one must also cope with the acoustics of the particular building.

Many of the smaller groups merely adjust their sound on stage with one member at the back of the hall giving a subjective indication of the sound he is hearing. Larger groups often employ a person whose main function is to ensure that the final sound is exactly as it should be (as regards volume, mix, quality, etc).

The 8-channel mixer described in this article will allow the total sound to be adjusted at the one point – perhaps the rear of the hall, while at the same time, eliminating several expensive amplifiers, and still ensuring an optimum overall sound. (This is only part of the story as the reader will realize from the full description of the unit).

INPUTS

As the name of the unit indicates, there are eight separate input channels. Each of these input channels has two input sockets, one of 47k impedance, and the other adjustable by changing one resistor, (maximum 4.7k). In our case we have a 200 ohm resistor in circuit so we shall refer to the 200 ohm input from here on.

Each input channel has a slide control potentiometer for volume. This potentiometer is in series with a sensitivity network that is adjusted by a three position slide switch.

The remaining input channel controls are rotary potentiometers facilitating balance, bass, treble and echo-send volume. We shall discuss these controls in detail later in this article.

Each input, after passing through the preamplifier and tone control stages, is divided to provide identical signals. The relative level of these signals can be varied by the input channel balance control. The outputs from the balance controls drive the output mixers. This creates a stereo effect, allowing the performers to be audibly "positioned" on stage.

OUTPUTS

The unit has two output channels. The unit can of course be modified simply to provide one main output and an onstage monitor output. These receive signals from the input channel balance controls and external echo unit, or similar, if one is employed. Rotating any of the input channel balance or echo-send controls will affect the output for that particular input only.

There are also controls provided for overall volume, balance and echo volume. Finally five more rotary controls per output channel have been provided for frequency equalisation. These allow compensation for hall acoustics etc. These controls operate at 60Hz, 240Hz, 1000Hz, 3500Hz and and 10kHz and provide approximately 10dB boost or cut.

Two VU meters also feature on the front panel, together with an overload indicator light which becomes

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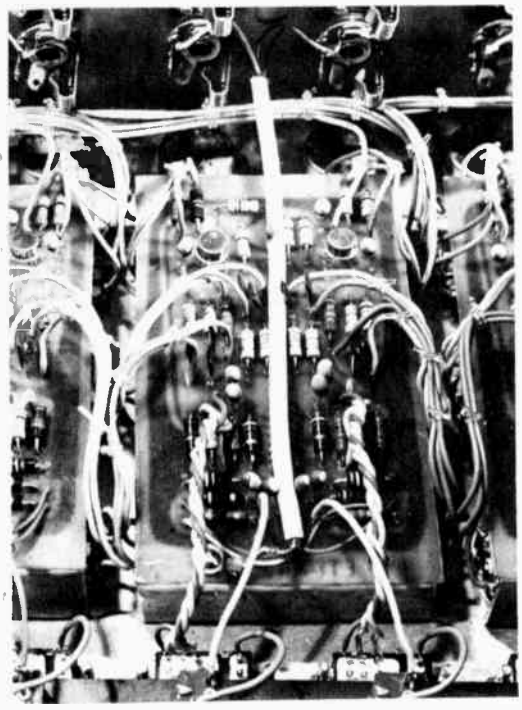


Input pre-amps are built in modular form — two to each board.

illuminated should either output exceed one volt — which is the overload point of the 100 watt amplifier published in the December 1972 issue.

Having briefly covered the various controls and facilities provided, we shall now describe the operation and specifications of each section more extensively before we commence constructional details.

Each input channel is identical, so we only need concern ourselves with one.

The two input jacks for each channel are situated at the back of the unit, directly behind their respective control panels.

The 47k input is typical for electric guitar pickups, microphones and such, but if long leads are used, problems could arise due to hum pickup or other radiated interference. If this is the case, a matching stage or transformer may have to be inserted between the input source and the low impedance input socket.

Some microphones have an impedance of 50k, and in this case the same would apply if long leads are to be used. The optimum situation is a low impedance source (microphone etc) into the low impedance socket, but if there is a mismatch, a low impedance source and a high impedance input is preferable.

There may be situations where one wishes to feed two or three microphones to the same input channel. In this case a separate low cost mixer would be needed.

The situation above could occur for example with a drummer or with organs that have more than one output.

Each input employs an operational amplifier. The gain of this amplifier is varied by changing the negative feedback, as is customary with this type of device. Maximum gains of 20dB, 40dB and 55dB are available via the volume control and the switched sensitivity network.

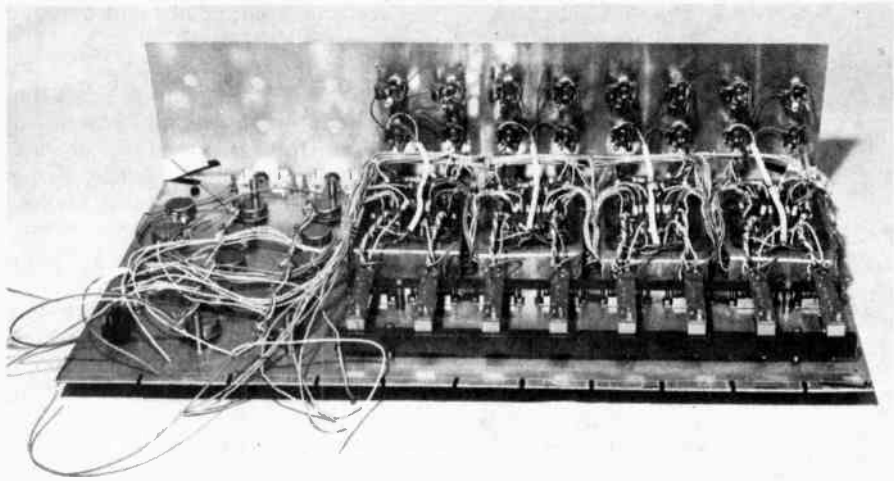
The output from each input op-amp, feeds a second op-amp which acts as a tone control stage. The output from each tone control stage is then fed via a potentiometer to one of eight inputs of an echo send mixer I.C., and is also split by the input channel balance control network before being diverted to the output channel mixers.

The output from the echo-send mixer is brought out at the rear of the unit. This output is intended to drive a complete echo or reverberation unit etc. The output from the external unit is then fed back into the unit via another socket to a resistive splitter, which provides two identical signals for the output mixers. It is important to realize that all signals are "echoed" if their particular echo send controls are turned up, and that both output channels amplify the result equally, as indicated above. The overall echo gain control varies the feedback of the echo-send mixer.

SPECIFICATIONS

Inputs	eight (but may be expanded or reduced — in multiples of two — as desired)
Input impedance (high)	47k
(low)	nominally 200 ohms, but may be any preset value under 4.7k
Sensitivity (high impedance input)	10mV
(low impedance input)	1mV
Tone controls (on each input)	bass ±10dB at 100Hz treble ±10dB at 10kHz
Outputs	two, left and right
Output level	maximum 5 V rms
Output impedance	approx 4000 ohms
Output tone control	each channel has its own equalizer providing ±10dB boost or cut at following frequencies — 60Hz; 240Hz; 1kHz; 3.5kHz; 10kHz

ETI MASTER-MIXER



This photograph was taken during construction of our prototype unit. The four input pre-amps may be seen on the right. Directly in front of the pre-amps are the slide potentiometers used for individual volume controls.

A nine-input mixer I.C. is employed at the input of each output channel. One of the nine inputs is in both cases used for echo input, while the others take the outputs from the eight input channels. The negative feedback of these op-amps is varied for overall volume control.

The outputs from the main mixers pass through the graphic equalisers and then to an overall balance control. The two VU meters and the overload indicator are connected at the output of the unit.

The metal panel of our unit is folded from one piece of 18 gauge steel. Eleven aluminium escutchions are used, although of only three different types. These should be available from kit suppliers, however should the reader wish to make his own panels and cabinet, diagrams of both metalwork and woodwork will be published in a later issue of this magazine.

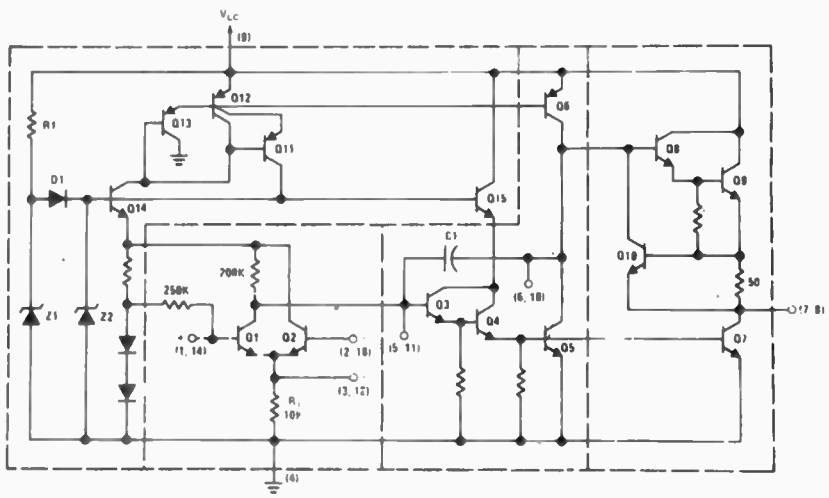
The main purpose of this introductory article has been to familiarise the reader with the project without becoming too involved with actual circuitry and construction.

We conclude this month with a description of the I.C. we have employed in the preamplifier stages.

The device is a National type LM381 dual low noise preamplifier I.C.

This I.C. has been available for about six months, and has recently become reduced in price. We have used one I.C. per every two input channels – a total of four, if one requires all input channels.

(Continued on Page 59)



Circuit of National type LM381 dual low-noise pre-amplifier IC used in the 8-channel mixer.

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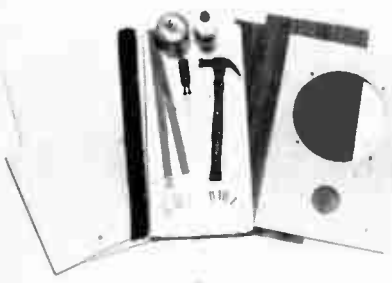

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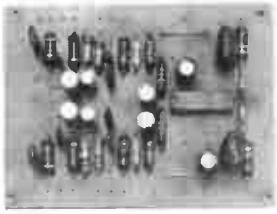

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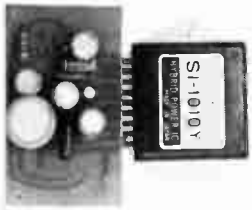

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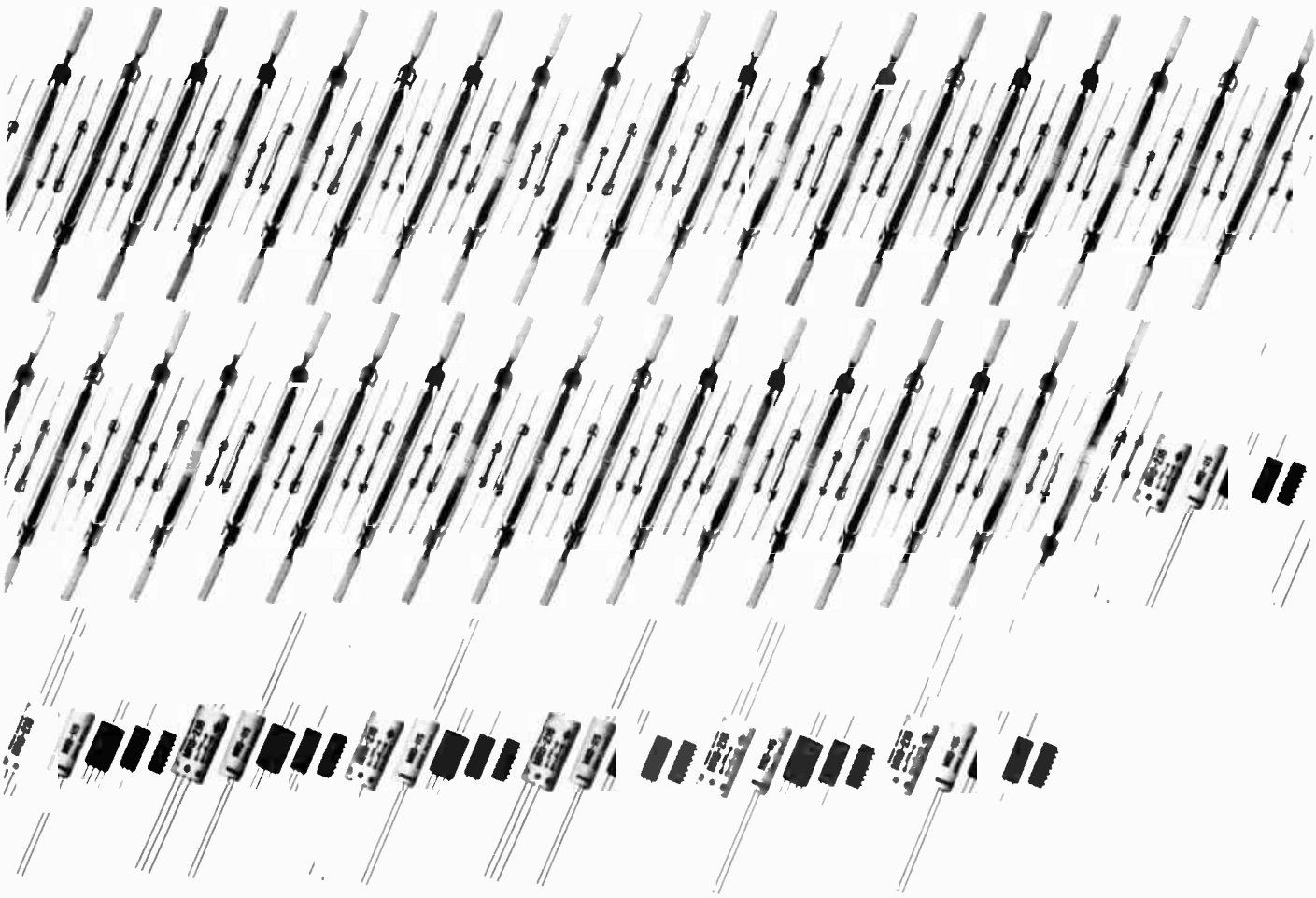

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AC62

ETI MASTER-MIXER

(Continued from Page 54)

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The maximum recommended input voltage is 300mV, and the typical available peak-to-peak output voltage swing is Vcc minus two volts. This I.C. is short circuit protected.

Circuit diagrams and descriptions and constructional details of this unit will commence in our next issue. ●

RADIO ASTRONOMY FOR AMATEURS

a series - by Roger Harrison VK2ZTB ex-VK3ZRY

PART XII
Design and Construction of line matching transformers

Line matching transformers are used for matching different impedances in a transmission line or antenna system by using a short length of the same type of transmission line of a different impedance.

The general arrangement is shown in Fig. 1. The length of the line matching section is an electrical quarterwave. If air is the dielectric then the length is given by:—

$$\text{Length} = \frac{2880}{\text{Frequency}}$$

where the length will be in inches and the frequency in MHz.

If another dielectric is used, then this length must be multiplied by the velocity factor of the transmission line used as the line matching section. For example, if RG8AU 50 ohm coax is used as a matching section, the length will have to be multiplied by 0.66 which is the velocity factor of RG8AU. (Manufacturers usually supply data on the velocity factor of their transmission lines).

To effect the impedance change the line matching section must have an impedance which is the algebraic mean between the input and output impedances. Thus Z_m of the matching line is given by:—

$$Zm = \sqrt{Z\text{ in} \times Z\text{ out}}$$

Thus, if the impedance of the driven element in an antenna is 200 ohms, and we wish to match this to a 450 ohm balanced open wire line; then: $Zm = 200 \times 450 = 300$ ohms. Thus a length of 300 ohm transmission line would be used. This could be ordinary TV ribbon. (The velocity factor of TV ribbon is about 0.85). Therefore the length would be:

$$\text{Length} = \frac{2880 \times 0.85}{\text{Frequency}}$$

and, given a frequency of 140 MHz

$$= \frac{2880 \times 0.85}{140}$$

Thus, Length = 17½ inches.

The line matching section is not always of a convenient impedance, Fig. 2 is a graph giving design information to enable you to construct a suitable section. It can also be used for designing open-wire transmission lines. Characteristic impedance versus centre-to-centre line

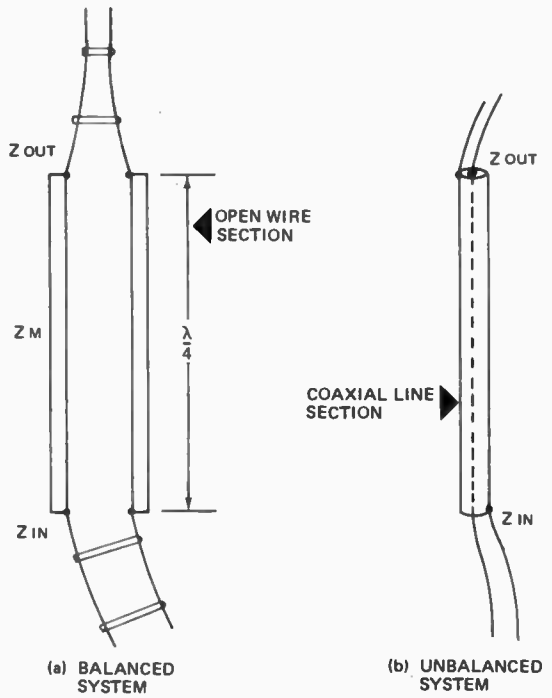


Fig. 1 Linear matching transformers

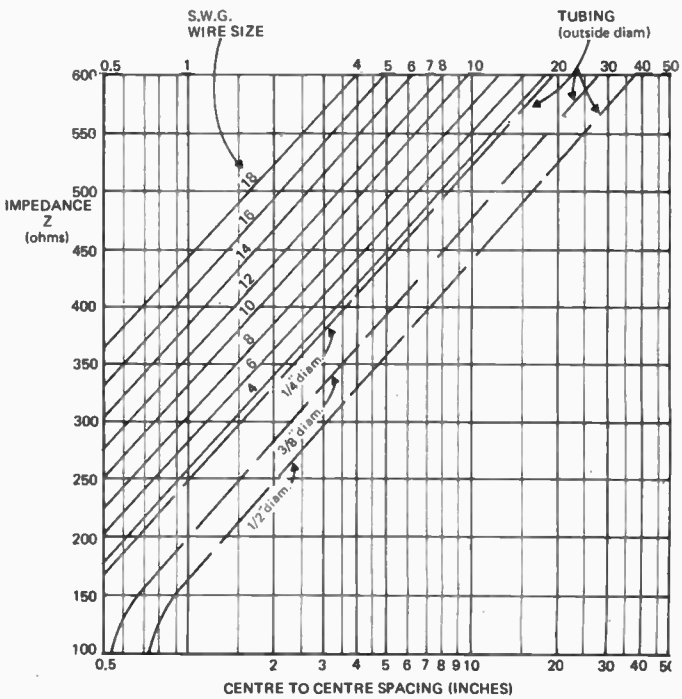


Fig. 2 Open-wire transmisssion line design

spacing is given for various wire and tubing diameters.

It is rarely practical to construct a coaxial transmission line matching section. Often the impedance of the system can be designed such that a standard line can be used. There are advantages to using open-wire transmission line in some applications, generally for short runs only, and transforming to coaxial line at a convenient point in the system. For example, where an array of several Yagis is used, the cheapest (and the easiest to adjust when coupling them together) is to use open wire line. The balanced, open-wire line is then transformed down to the impedance of a suitable coaxial line and the system changed from balanced to unbalanced at the same time. The coupling of arrays of antennas will be described later in this article.

COAXIAL BALUNS

As mentioned previously, a balun is used to connect a balanced transmission line or termination to an unbalanced one. The simplest type is shown in Fig. 3. The impedance, balanced to unbalanced, remains unchanged, and this balun is often employed to match coaxial cable to low impedance dipoles. It is usable at one frequency only. The length is given by the same formula as for the line matching transformer. The velocity factor of the coaxial cable does not have to be taken into account.

The two parallel sections of cable form a transmission line, the dielectric being air. This balun can be made of coaxial cable or suitable sized tubing as shown in Figs. 3(a) and (b).

The balun illustrated in Fig. 4 also performs the useful function of transforming the impedance, balanced to unbalanced, by a ratio of four-to-one. Readily constructed out of coaxial cable it is often used directly at the feed point of an antenna. The length of the loop is an electrical half-wave and is given by:

$$L, \text{inches} = \frac{5905 \times \text{Velocity Factor}}{\text{Frequency (in MHz)}}$$

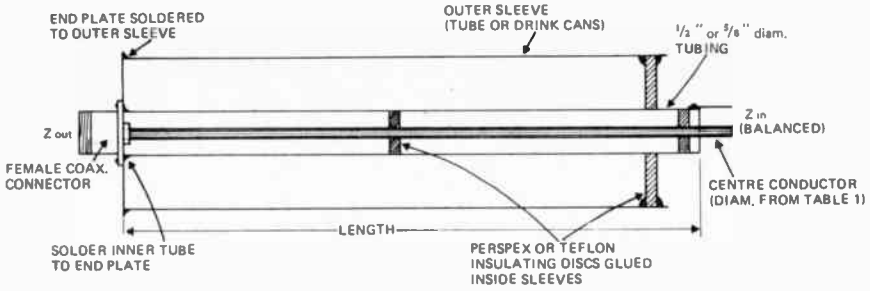


Fig. 5 Combined transformer/balun

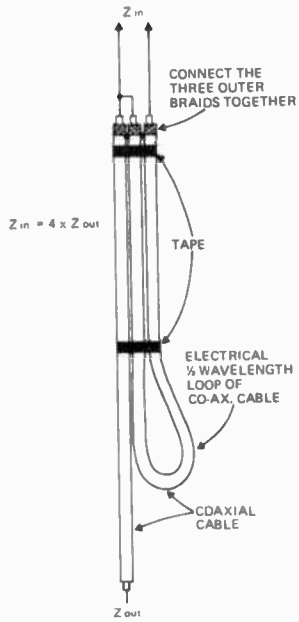


Fig. 4 Combined coaxial balun/transformer

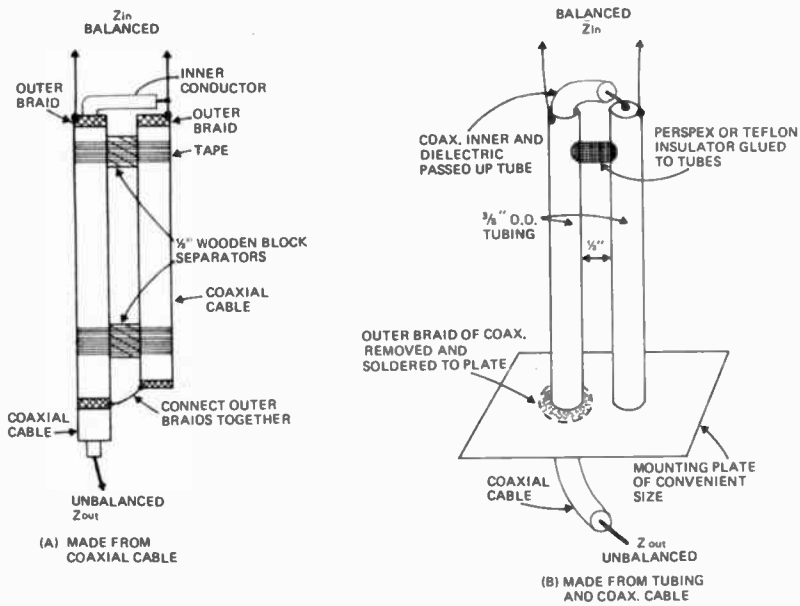


Fig. 3 Coaxial baluns of simple construction

As the velocity factor of most solid dielectric coaxial cables is 0.66; the formula becomes:—

$$L, \text{inches} = \frac{3898}{\text{Frequency (MHz)}}$$

If coaxial cable employing cellular polythene dielectric is used, having a velocity factor of 0.86, the formula becomes:—

$$L, \text{inches} = \frac{5080}{\text{Frequency (MHz)}}$$

For 52 ohm coaxial cable such as RG9AU, Z_{IN} must be 208 ohms. If 72 ohm coaxial cable such as ET13M, is used, Z_{IN} must be 300 ohms.

The line matching section and the balun/transformer can be combined to produce a very efficient balun and matching system that is somewhat more difficult to construct than those just mentioned. This device is illustrated in Fig. 5.

The length of the outer sleeve is half an inch shorter than the inner section. The length of the inner section is given by:—

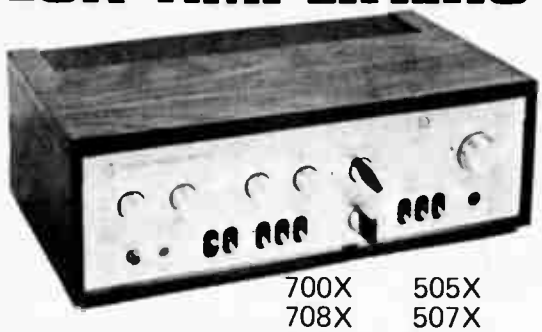
$$L, \text{inches} = \frac{2880}{\text{Frequency (MHz)}}$$

The outer sleeve can be constructed from tubing (or beer cans). The inner conductor of the inner section can be a suitable gauge wire depending on the impedance transformation desired. Table 1 gives information for most common impedances encountered. The device should be mounted vertically with the coaxial cable coming out through the top in order to keep the rain out. Tape and seal the male coaxial connector with a suitable goo such as "Selleys" sealing compound. Painting the outside of the outer sleeve will help to reduce the effects of weathering.

WIRE GAUGE	UNBALANCED Z out 50Ω	UNBALANCED Z out 75Ω	BALANCED Z in
8	8	12	200
12	12	16	300
16	16	20	450
20	20	24	600

TABLE 1

LUX AMPLIFIERS



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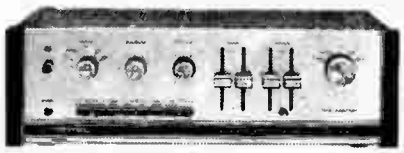

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RADIO ASTRONOMY FOR AMATEURS

COUPLING STACKED ANTENNAS

When stacked arrays are used, there arise problems in coupling them so as equally to distribute the received signal power, as well as matching the whole array to a suitable feedline.

The most successful method is to use a completely symmetrical feed system employing balanced lines and matching sections.

Two examples are given in Figs. 6 (a) and (b). Note that a bay of four antennae is merely a two-stack doubled. Thus, if you wish to make a large array of arrays you must increase the number of individual antennae by a power of two every time you increase the number of antennae. For instance: say you have a bay of four antennae, you must add another four if you wish to increase the size of the array. Otherwise, little is gained in resolution.

The systems shown in Fig. 5 are simple and will function well without requiring critical adjustment.

Here are a few tips for the successful construction of such a system:—

(a) Use folded dipoles in all antennae.
(b) Use balance lines in all the phasing lines.
(c) Make the phasing lines all the same impedance and of the same material (if home constructed) or of the same type if commercial tranmission line is used.
(d) Make all the phasing lines exactly the same length and no longer than is really necessary. Lines P1 and P2 need not be equal.
(e) The antennae must be identical and well matched to the phasing line. Conduct tests and take measurements on each one individually if necessary.
(f) Phasing lines must all have the same polarity to maintain proper phasing. In other words, make certain that all the right-hand terminals of the driven elements are connected together, and similarly for the left-hand ones.
(g) Support the phasing lines where possible but keep them clear of the antennae, support masts etc. Where the lines join each other, and matching devices etc. they should be run in different directions rather than parallel to each other.

The whole array can finally be attached to a suitable balun so that coaxial cable can be used for the main transmission line.

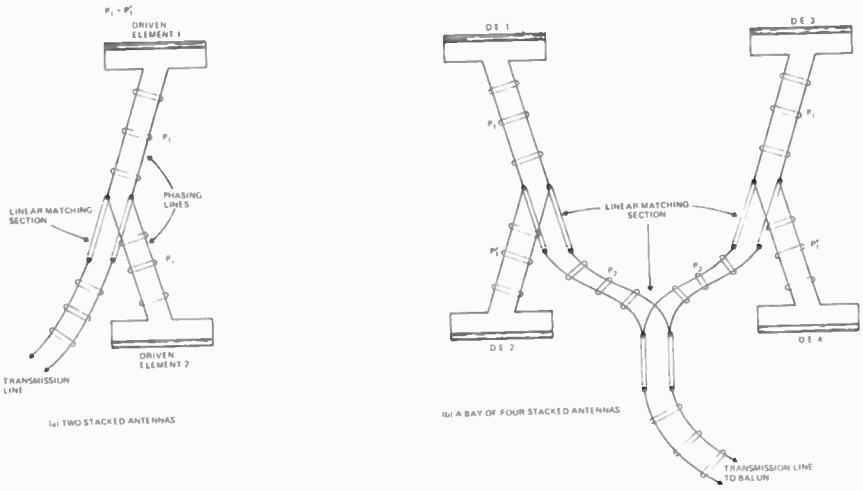


Fig. 6 Coupling stacked antennae

COUPLING TWO ANTENNAE WITH COAXIAL CABLE

Where only two antennae are stacked, they can be coupled by a very simple method using coaxial cable. If the impedance of the driven element is designed to match 75 ohm unbalanced, and the main transmission line must be 75 ohm coaxial cable, then the system illustrated in Fig. 7 is a very easy solution. Here two electrically half-wave sections of coaxial cable (any impedance) are paralleled at the ends, as shown, using either a manufactured coaxial fitting "Tee" piece or a home-made one as in the inset. A linear matching transformer of 50 ohm coaxial cable, and electrical quarter wave long, is then used to transform the paralleled 75 ohm impedances (now 37.5 ohm) back to 75 ohm. Measure all lengths *carefully* taking any coaxial fittings into account.

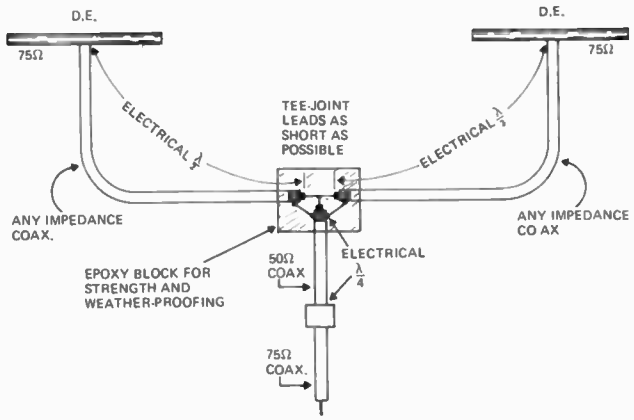


Fig. 7 Coupling two low impedance arrays with coax.

The appropriate lengths of cable can be calculated from the formulae given previously.

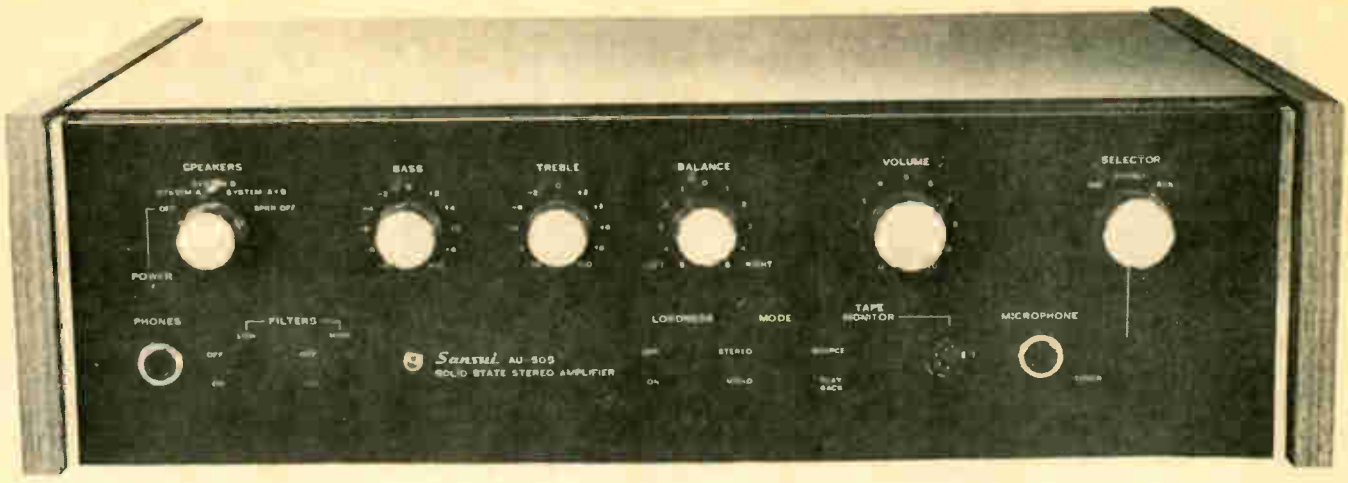
Use the best coaxial cable you can afford and avoid long lengths.

Mount a preamplifier at the antenna — performance is considerably improved in most cases if these simple measures are taken.

When using open-wire transmission line, support it only sufficiently to prevent it moving very much in the wind. Keep it tight. Straight runs are preferable. Any bends should be obtuse or over a large radius. If using home constructed open wire line, use only sufficient insulators to keep the lines parallel and supported.

Avoid running open-wire line parallel to metal structures — if necessary, make a parallel run very short. Twist the line several times to help preserve balance.

When joining coaxial cable together or to a piece of equipment, use good quality, constant impedance connectors such as BNC for ¼" diameter coaxial cable or type N or C for 3/8" or ½" diameter coaxial cable. Always use low-loss coaxial cable, the ½" or 3/8" diameter variety is better than the smaller type. There is less loss. Types ET13M and UR67 are excellent and not expensive. They are useful into the VHF region. ●



SANSUI AMPLIFIER AU 505

electronics TODAY INTERNATIONAL
product test

Latest medium-price amplifier from Sansui produces 23 watts/channel.

At first appearances the AU 505 is nearly identical to the AU 101 that we reviewed in the 1971 May issue. However power output of this new unit (at rated input level), is 23 watts whilst that of the AU 101 is 15 watts.

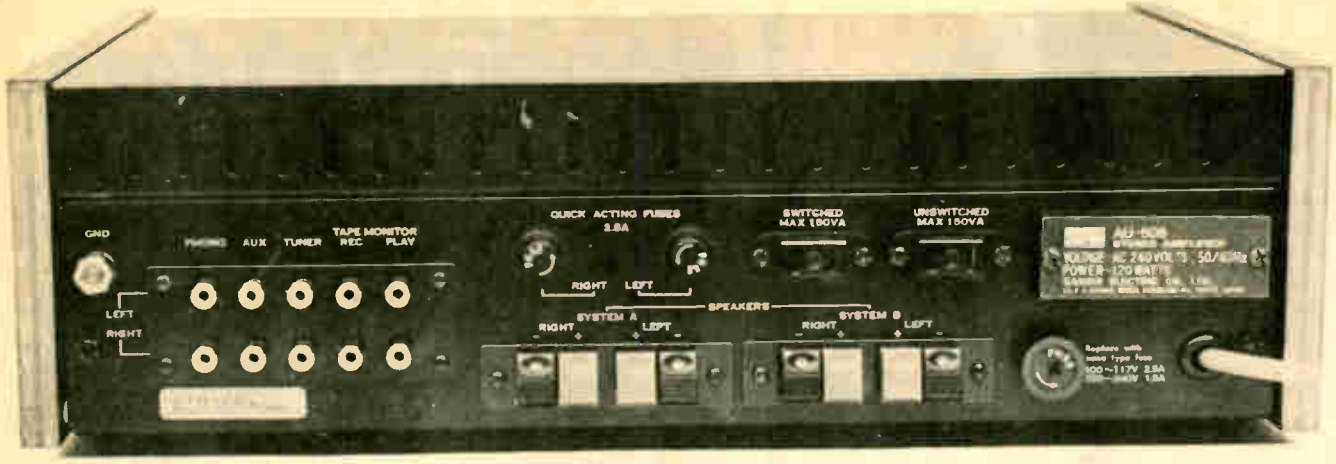
The only external difference is the addition of three level-switches and the changing of the rotary power "ON OFF" switch to a combined power/speaker selection switch.

The external appearance is traditionally Sansui, with a black front panel framed at each end by a chromed strip, and veneered timber side panels.

The top row of controls consists of four small chromed knobs and two large chromed knobs. These knobs provide the following facilities, from left to right:—

a) Mains "ON OFF" speaker select switch with five positions — mains OFF, speaker system A, speaker system B, speaker system A & B and speakers OFF.
b) Continuously variable bass control, with marked 2dB steps from -10dB to +10dB.
c) Continuously variable treble control, with marked 2dB steps from -10db to +10dB.
d) Balance control.
e) Volume control continuously variable, and marked from 0 to 10.
f) Source selection control with three positions: microphone, phono and auxiliary.

This arrangement of controls follows the general trend of some of the better quality amplifier manufacturers in that



the two most used switches, the power "ON OFF" speaker selection switch, and the source select switch, are located in the top left hand and right hand corners respectively. The amplifier therefore was very easy to adapt to and operation was straight forward.

The bottom row of controls are as follows from left to right:

a) Ring tip and sleeve socket for headphones.
b) Black aluminium lever switch for low frequency cut off.
c) Black aluminium lever switch for high frequency cut off.
d) Small mains ON bezel.
e) Black aluminium lever switch for loudness control.
f) Black aluminium lever switch for stereo or mono mode selection.
g) Black aluminium lever switch for tape monitoring — source of playback.
h) Five pin DIN socket for combination tape-recorder, record playback DIN patch cord.
j) Tip and sleeve socket for microphone input to right channel only.
k) Black aluminium lever switch for tuner input select.

All other input and output facilities are located on the rear panel and consist of the following:

SANSUI AMPLIFIER AU505
MODEL AU 505 SERIAL NO. 022051203

Power Output		
(For rated input of 200 mV into 8 ohms)		
Both channels driven	20W	
One channel driven	25W	
Frequency Response	20Hz to 20kHz ± 1dB	
Channel Separation		
	100Hz	1kHz
Auxiliary input	50dB	45dB
Phono input	47dB	45dB
Hum and Noise		
(Unweighted with respect to rated power of 23W)		
Auxiliary	84dB	
Phono	64dB	
Input Sensitivities		
(For rated power — 23W)		
Phono input	2.9 mV	
Auxiliary input	205 mV	
Tuner	205 mV	
Total Harmonic Distortion		
(At rated output — 23W)	100Hz 0.39%	
	1kHz 0.55%	
	6.3kHz 1.2%	
Tone Controls		
Bass	12db Boost at 50Hz	
	15dB Cut at 50Hz	
Treble	10dB Boost at 10kHz	
	12dB Cut at 10kHz	
Loudness Control	8dB Boost at 50Hz	
	7dB Boost at 10kHz	
Filters		
High	9dB Cut at 10kHz	
Low	10dB Cut at 50Hz	
Dimensions	115mm x 407mm x 278mm	
Weight	8.0kg.	

Badly punched tape doesn't faze the Facit 4001 tape reader

Look at these tapes.

One of them has pitch inaccuracy of +25%, the other of −25%. According to ISO standards, tolerance should not exceed ±0.5 over 50 characters. The majority of tape readers cannot cope with tolerances greater than this. But the Facit 4001 can.

It reads practically every tape, no matter how badly punched it is. Correctly. At a speed of 1000 characters per second. Even completely transparent tapes. Owing to dielectric sensing and capstan tape feed.

If you choose the Facit 4001 you will also get a tape reader that only needs servicing once a year.

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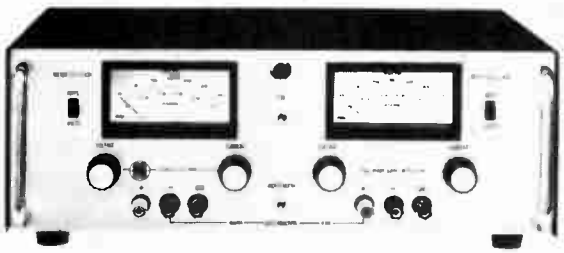

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- Output Current to 2 Amps
- Excellent Line and Load Regulation
- 0° to 60°C Operating Temperature
- Ten Turn Controls
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- Constant Voltage/Constant Current

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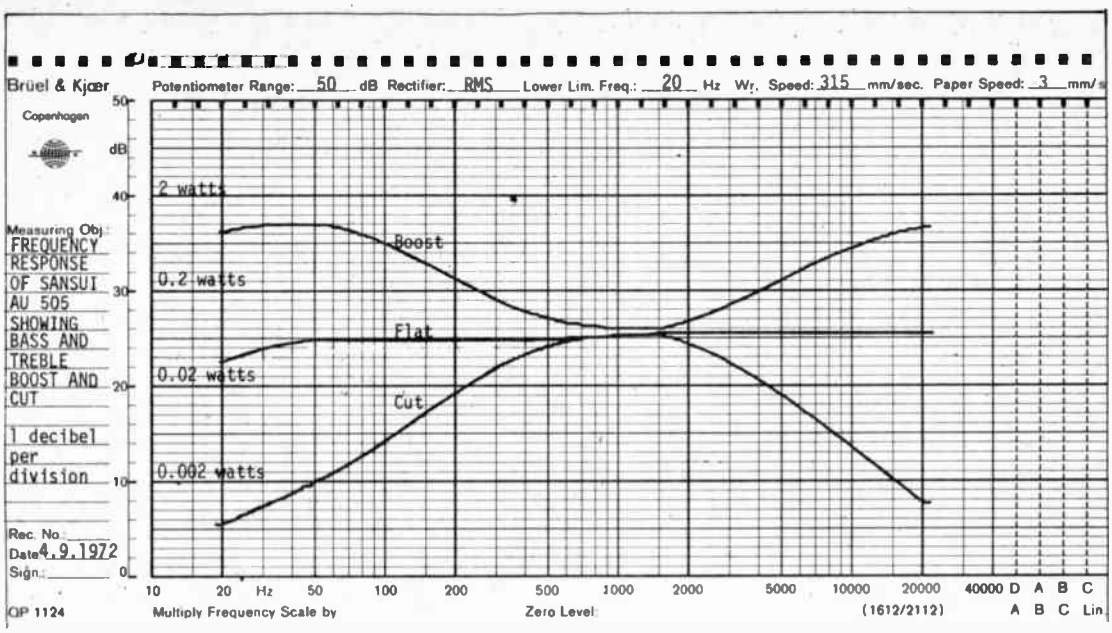
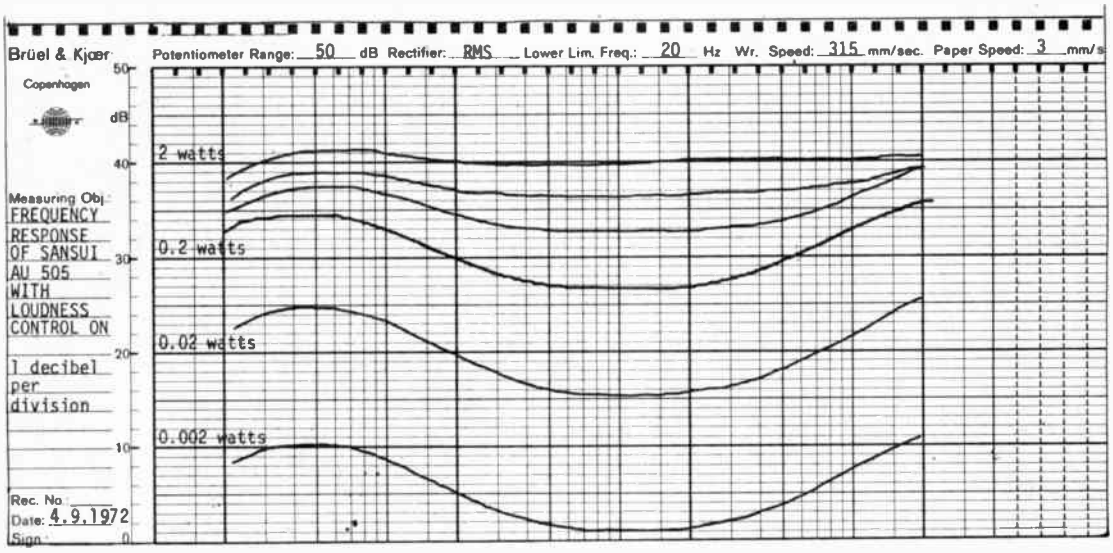
SANSUI AMPLIFIER AU 505





Five pairs of RCA sockets for –

a) Phono input.
b) Auxiliary input.
c) Tuner input.
d) Tape recorder output.
e) Tape recorder monitor input.

Spring loaded terminals are used for the speaker outputs. Other features included on the back panel are one switched and one unswitched two-pin mains output sockets for powering auxiliary equipment, and a large ground terminal.

Three fuse holders are also located on the back. A 1.5A fuse is wired into the mains input and 2.5A quick acting fuses are inserted in each supply rail to the power amplifier stages.

A five pin DIN socket located on the front panel is a very practical arrangement. So often one needs to connect someone else's tape-recorder into one's own system and as a result has quite a problem making all the necessary interconnections. The difficulty is often compounded by the amplifier being located in a dark confined space.

Sansui's use of a front-mounted DIN socket is therefore very worthwhile. Had it been possible to switch select inputs from either the front DIN socket and the rear DCA sockets the arrangement would be of even greater value.

The internal layout is extremely neat and uncluttered and provides easy access to all components. The printed circuit boards are clearly marked with component numbers and eyelets labelled emitter, base and collector for each transistor. The power transformer is fully shielded and at the opposite end to the inputs and preamplifiers.

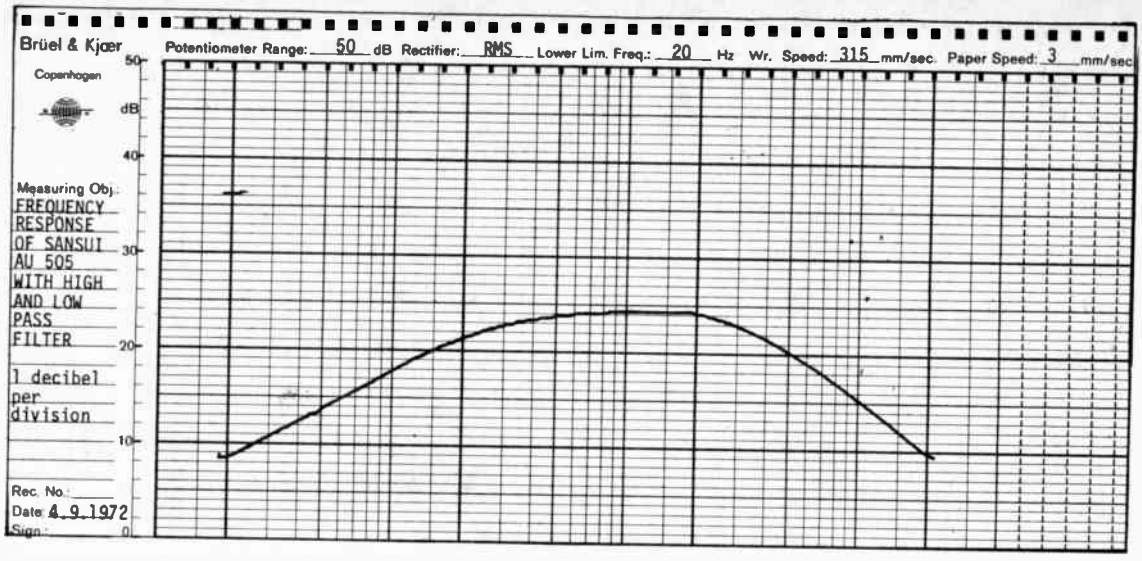
MEASURED PERFORMANCE

The measured performance was very good with most parameters meeting the manufacturer's specification. Hum and noise was unusually low – being -64dB on the Phono input and -84dB on the Auxiliary input.

The loudness control becomes effective below approximately two watts output. This is an ideal setting for the average domestic speaker/room combination. It is however rather abrupt in operation – going from a flat response to full treble and bass boost within 7dB.

Although within the manufacturer's specification, harmonic distortion was

SANSUI AMPLIFIER AU 505



higher than expected – exceeding 1% at 6.3kHz at rated output (23W with both channels driven).

As with all Sansui equipment, a large plasticized operations card was supplied. Details of all the front panel control functions are shown on one side of the card and the other side shows how all the rear panel connections should be made, including making up patch cords with the R.C.A. plugs supplied with the amplifier. Also included with the card is a ten page "Operating Instructions and Service Manual", a Warranty card and a cloth for polishing the timber cabinet. The manual devotes most of its pages to wiring diagrams and component layouts on the printed circuit boards. Photographs in the manual are used to show the location of all the major components on the amplifier chassis.

The AU 505 amplifier is another example of the ability of the Sansui Electric Co. Ltd. of Japan to produce a top quality amplifier at a sensible price for the domestic market. It combines a pleasing external appearance which would match most decors with an adequate set of functions for various sources and modes of operation. ●

Recommended Selling Price
$199.00

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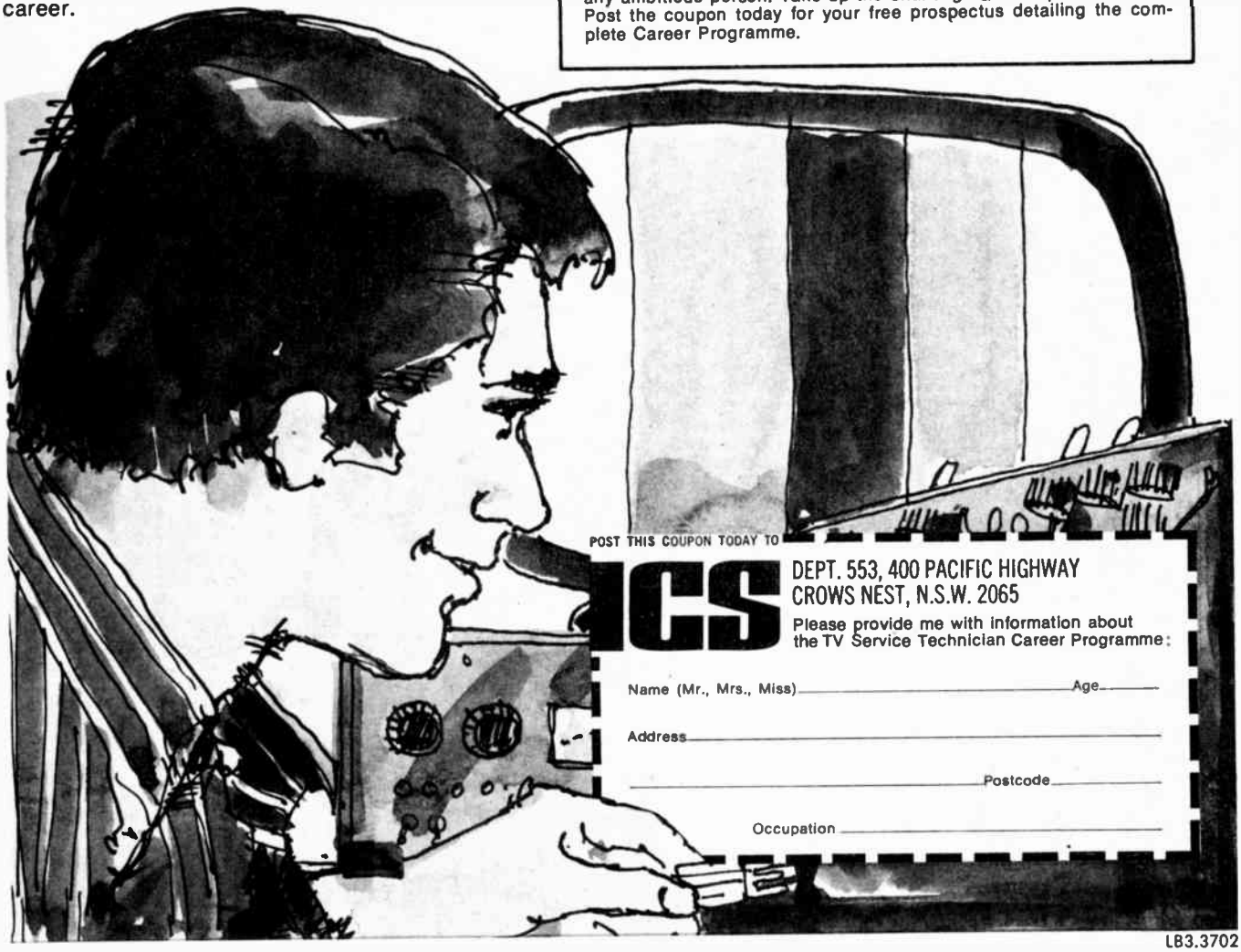

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TURN INDICATOR CANCELLER

Simple electronic unit cancels turn indicators after 30 seconds.

ETI PROJECT 308

For some time now it has been compulsory for drivers of vehicles fitted with turn indicators to signal right and left turns, and, to cancel the turn indicator after a turn.

All modern cars on the market are fitted with turn indicators that automatically cancel, however, this is not true of motor cycles. But legislation has now been extended to motor cycles, and riders forgetting to cancel the indicator may well find themselves up for a $10 fine.

Electronics Today presents this project specifically to help these people avoid fines. The unit described offers an economical means of ensuring that turn indicators are switched off automatically 30 seconds after a signal has been initiated.

CONSTRUCTION

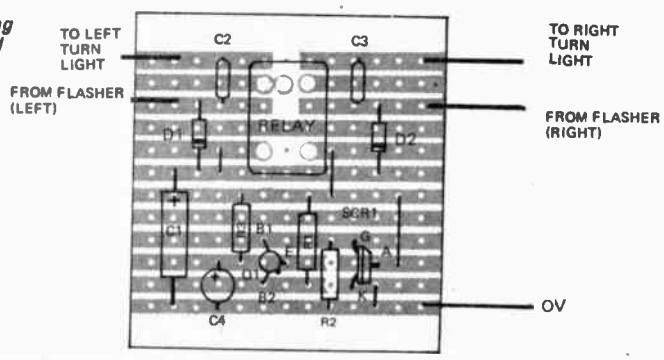
There are only 12 components all told, therefore there should be no problems with construction providing the wiring diagram and overlay are studied carefully.

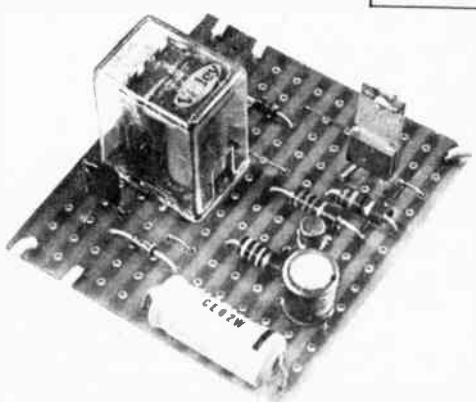
Most motor cycles have six volt power, either from a battery, or mag-dynamo and in this case a relay with 52 ohm coil should be used. Where a 12 volt system is used, the relay should have a 185 ohm coil.

Locating the unit will be a matter of choice, and will depend on the particular machine — for this reason we have not provided case details. The unit should be mounted as close to the turn signal switch as possible so that long leads are not necessary.

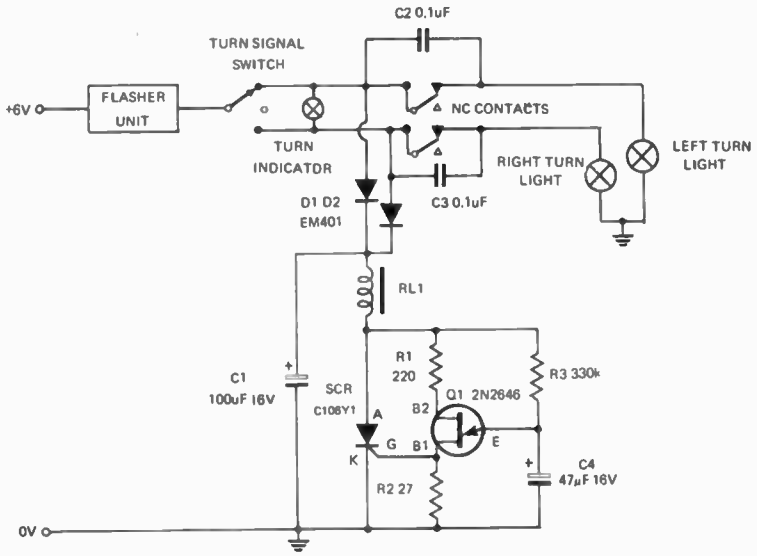
To wire the unit into the turn indicator circuit, locate the two wires coming from the flasher, cut both and connect them as shown on our overlay diagram. There is no need to identify left and right, so long as each wire is cut and then terminated with both sections on one side of the matrix board as shown.

For the motor cycle enthusiasts amongst our readers, the machine in our lead picture is the latest 4-cyl 900cc. Kawasaki. Lucky lady handling it so expertly is our associated magazine Revs Motorcycle News' editorial assistant Christine Froebel

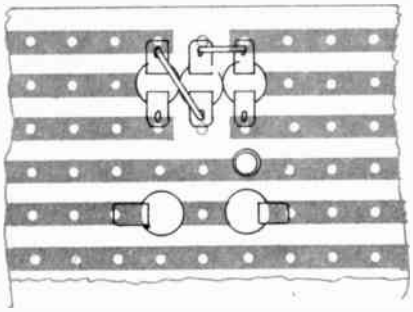




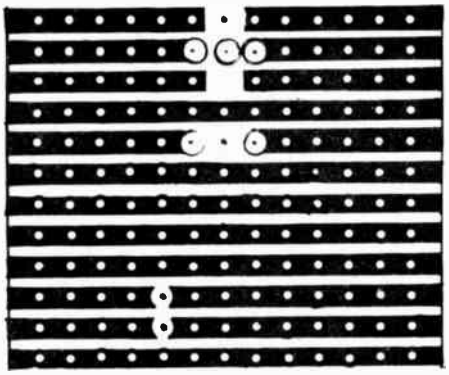
How the components are mounted on the printed circuit board. (For relay connections see accompanying drawing). Refer also to photograph left.!



Circuit diagram of complete unit.



Relay connections. Holes should be drilled through the veroboard large enough to accomodate the twin tags. The tags are then bent over and soldered as shown.



Use a sharp drill to break the tracks on the veroboard as shown. Several holes must be enlarged to enable the relay tags to pass through.

HOW IT WORKS

When either blinker is switched on, pulses from the flasher unit charge C1 and C4 via either D1 or D2, and in the case of C4, also via the relay winding and R3. When the charge on C4 is sufficient to trigger UJT Q1, a pulse occurs across R2. This in turn gates the SCR on allowing C1 to discharge via the relay and the SCR. The C1 discharge current through the relay winding actuates the relay and the normally closed contacts are opened, breaking the current path to the light concerned.

This removes the major load on the flasher unit, which then stays on. Providing the indicator switch is left on, the SCR will continue conducting via the relay winding, thus the contacts remain open. Since the timing circuit is directly across the SCR, it is reset immediately the SCR turns on which ensures that the next timing period will be the same as the first. Switching the indicator switch to the off position, removes power from the relay and it then drops out.

The blinker on-time is determined by the C4/R3 time constant – in this case about 30 seconds. Increasing the value of either component lengthens the 'on' time, and vice versa. The capacitors across the relay contacts are included to protect the contacts from arcing.

PARTS LIST ETI 308

SCR	—	silicon controlled rectifier C106Y1
Q1	—	unijunction transistor 2N2646
D1, D2	—	silicon diode EM401, BY126/100 etc
R1	—	resistor 220 ohm, ½ watt, 10%
R2	—	resistor, 27 ohm, ½ watt, 10%
R3	—	resistor, 330k, ½ watt, 10%
C1	—	electrolytic capacitor, 100uF, 16V, pigtail
C2, C3	—	polyester capacitor, 0.1uF, 100V
C4	—	electrolytic capacitor, 47uF, 16V, upright
Relay	—	miniature relay type VP2, 5A. For 6V vehicles (52 ohm coil), 12V vehicles 185 ohm coil — see text
Veroboard	—	2¾ inches wide, 3 inches long, 0.2 inch spacing
Sundries	—	hookup wire, solder etc.

PART 10

TRANSDUCERS IN MEASUREMENT AND CONTROL

Dr. Sydenham of New England's University's Dept. of Geophysics describes various techniques used to measure flow.

Fluids in motion range from low density gases, through liquids to slurries, pulps and particulate substances such as wheat or sand. And they often require to be monitored to provide information on the rate at which a volume of fluid is passing a given area, or the rate at which a volume of fluid is passing a given area, or the rate at which the mass of the fluid is moving, or to monitor the total amount that has passed in a given time-interval. Examples are: pulp flow in paper making, blood flow in medicine, power station cooling-water rate, air speeds in weather forecasting, the flow rate of highly reactive liquid sodium in nuclear reactors. Flow rate measurement is also often required for delivery of exactly metered quantities of a substance.

As with all sensors, no universally applicable device or principle suffices for all the various needs. Many principles are invoked, in a variety of ways, in order to provide a satisfactory measurement from both performance and cost points of view.

FLOW CHARACTERISTICS

In general, most fluids needing measurement are conveyed in enclosed pipes, although in some instances open channels are used. It is, therefore, useful to know something about fluid transmission in pipes. Assuming the fluid is incompressible – water and oil come close to the ideal – then the flow rate is a measure of the volume (volumetric flow rate), or mass (gravimetric flow rate) passing a point in a given time, depending on which is of interest. The greater the velocity, the greater the volume (or mass) passing. However, a strict correspondence does not exist, and the relationship depends upon how the flow takes place in the conduit, which leads us to the two main types of flow that can exist in a pipe.

If the particles of the fluid flow in a smooth streamline manner – imagine the flow as numerous ultra thin layers slipping over each other with greatest velocity in the centre – then this is laminar flow. Empirical observation plus dimensional analysis of the

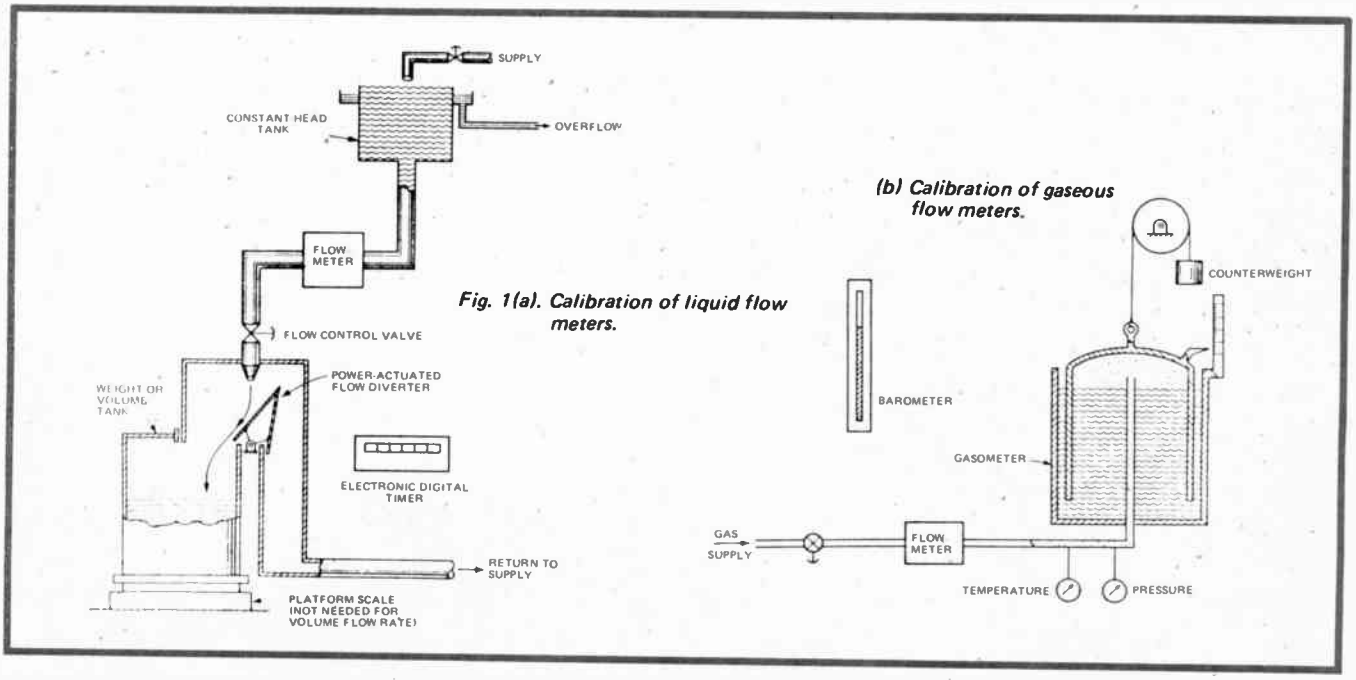


Fig. 1(a). Calibration of liquid flow meters.

relevant equations of fluid mechanics have yielded a very valuable characteristic number that depends upon the pipe diameter, fluid density and viscosity, and the flow rate. This Reynold's number (after O. Reynolds, 1883) will be around 2500 or less if the flow is laminar. We shall see later that correct flow measurement often requires that the flow through the transducer is laminar, so a section of pipe or straighteners are added to steady the flow before it enters the transducer.

If the flow is laminar, the velocity of the fluid particles will vary across the pipe section, the layer being stationary near the pipe-wall and fastest at the centre of the pipe section. The velocity gradient depends on the fluid and the pipe, so the average flow rate could be quite different from that indicated by a flow meter.

The other distinct flow type is called turbulent because the velocity at any point in the flow is random and no streamline flow exists. A Reynold's number greater than 4000 usually indicates turbulent flow. In between the two numbers, the flow depends upon the pipe-work system used. Obviously, rough edges, surfaces and steps in the pipe will cause turbulence for some distance down stream. Flow meters are therefore usually installed away from elbows, joints and valves.

To add to the problems, flows are often pulsating due, perhaps, to the use of a gear or piston pump. In recent years considerable research effort has been devoted to the study of pulsating flows. If possible, the rule is to circumvent pulsation problems by smoothing the flow with a storage tank, (which acts as an integrator), or by mounting the meter some distance away from the source of pulsation. Some flow meters operate without significant errors in pulsating conditions, but not all.

Flow, therefore, is a challenging variable to measure. Extreme care is needed in the selection of the method, and its application. A good understanding of basic fluid mechanics is essential.

Other factors that must be considered are that the components of the transducer will not be corroded by errosive chemical or cavitation forces. They must also be able to withstand the temperatures involved.

The majority of flow meters are designed to operate with a specified flow direction only, their principle will not work correctly the other way.

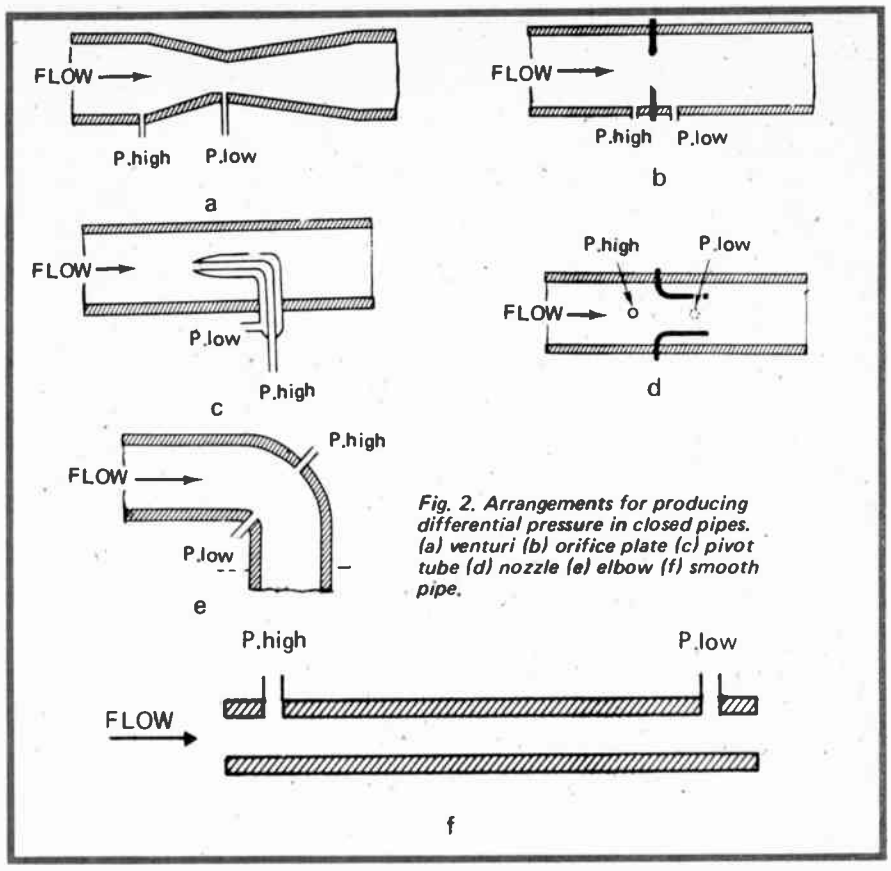


Fig. 2. Arrangements for producing differential pressure in closed pipes. (a) venturi (b) orifice plate (c) pivot tube (d) nozzle (e) elbow (f) smooth pipe.

CALIBRATION AND TESTING

In theory, flow (being mass or volume passing a given area in a given time) can be defined in terms of the fundamental mass, length and time units. The only satisfactory basic standard procedure is to pass steady flow through the device, collecting the fluid in a suitable weighing or volume measuring enclosure and measuring the time of flow. Schematics of gravimetric and volumetric test setups are shown in Fig. 1. Flowmeters so calibrated may then be used as substandards (the absolute methods are time consuming) to calibrate other flow meters in continuously flowing closed-circuits. An essential requirement with absolute methods is that the pressures to and from the transducer are maintained constant to ensure an even flow rate. Closed-circuit systems are used but pressure control is also needed. It is not always necessary to measure the entire flow in the pipe – shunts are often used to bypass a known percentage of the main flow through a parallel mounted, smaller, flow-meter circuit.

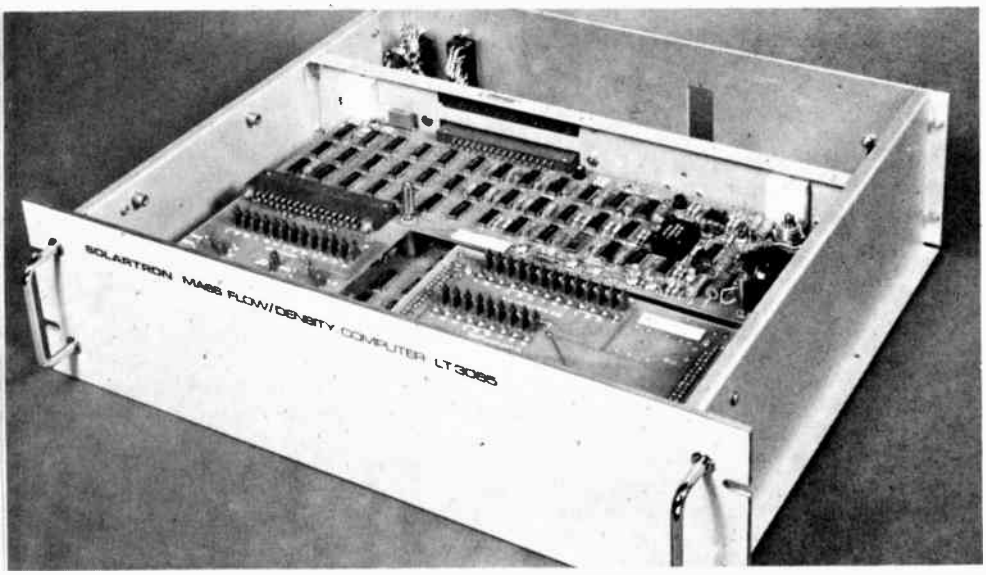


Fig. 3. Solid-state mass flow and density computer for use with differential pressure devices.

Having dealt with this background, we can now examine specific designs.

DIFFERENTIAL PRESSURE (d.p.) SENSING OF FLOW

In the middle 1700's, Bernoulli studied the ideal case for steay flow of an incompressible fluid in a frictionless pipe. He was able to relate the variables of a flow between two points — viz, pressure difference between the two points, velocity of flow and difference in pressure head — using a general energy-balance equation that now bears his name. If flow is restricted by narrowing down a short section of pipe, it can be shown from this equation, and from consideration of continuity of flow, (the mass leaving the restriction equals that entering it) that there will be a pressure difference between a point upstream and a point in the restriction. A cross-section of such a venturi device is shown in Fig. 2a. (Carburettors and spray guns use this principle to draw vapour into the air flow passing through the venturi). Flow rate, therefore, can be transduced into an intermediate secondary variable, pressure difference, which can be monitored with pressure transducers. Flow, however, is proportional to the square root of this pressure difference and linearization is needed. Pulsating flows are not indicated correctly, due to this non-linearity.

A simple way to invoke the same situation is to insert a plate, having a small hole in the centre, in the flow stream. These are called orifice plates (Fig. 2b). Again flow velocity is dependant (pressure difference) $^{1/2}$. The actual relationship depends critically upon the hole diameter, its profile and the fluid constants of viscosity and density. Every combination has a slightly different discharge coefficient. Standards have been established to ensure accurately related flows with the measured pressure differences. Orifice plates are available commercially. Other devices using the same concept in different ways are the Pitot tube and nozzles (shown in Fig. 2c and 2d).

A pressure difference is also produced between the outside and inside of a bend in the pipe work, (Fig. 2e), due to centrifugal force, and this is often used as a metering method. Again certain criteria must be adhered to, especially the use of a 'calming section' preceding the bend. Individual calibration is necessary.

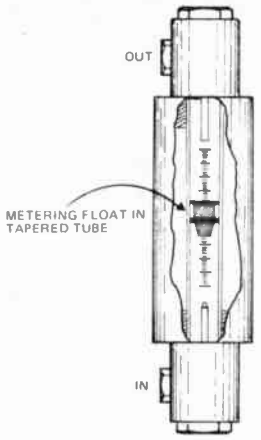
Yet another pressure difference device makes use of the pressure drop developed along an even-bore pipe by fluid friction effects (Fig. 2f). Although providing a smooth bore to flow, the resistance needed to develop enough pressure difference may be a disadvantage. To shorten the length whilst retaining smooth flow, one manufacturer offers a pipe filled with glass spheres for the same purpose.

The basic low cost, reasonable reliability and installation ease, made d.p. methods popular. Many instrument companies offer equipment that linearizes the d.p. signal to indicate flow or mass on a linear scale. An electro-mechanical system was described in the July, 1972 issue of Electronics Today International. A solid-state equipment is shown in Fig. 3.

Pipe sizes from hair size to many metres in diameter can be instrumented this way.

Obvious disadvantages of such methods are the need to maintain the restricted area free of debris and solid contaminants. The method is not used for highly viscous or particulate substances.

Fig. 4. Cross-section of a simple variable-area rotameter.



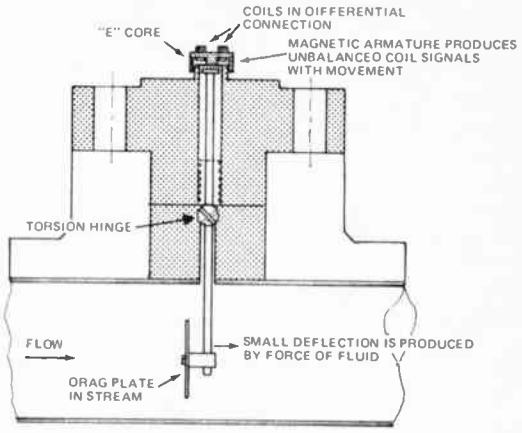


Fig. 5. Schematic of a drag-plate flow-meter having fast response, made at the National Engineering Laboratory.

DISPLACEMENT DEVICES

An object placed in the fluid stream experiences a force attempting to move it along. Many devices make use of this fact to provide an intermediate stage by which a linear or rotary displacement sensor is actuated.

The simplest meter uses a spring-loaded horizontal or vertically suspended object in a tube such that movement of the object alters the area through which the fluid is restricted. These variable area meters, in fact, produce a varying size orifice which maintains a constant pressure drop — in contrast to the constant area of the differential pressure methods. Inexpensive units visually indicate flow as the position of the float against an engraved scale (as shown in Fig. 4). By suitable design, the movement can be made linear with flow rate. They also cover a wider range of flows (10:1 is possible) than differential pressure methods. To obtain an electrical signal, the movement is measured with displacement transducers such as the inductive sensors or potentiometers.

Another displacement type is the turbine meter. If accurate metering of valuable fluids is needed, the blades are designed with seals that slide to ensure minimum bypass of fluid past the blades. (Often the pump is designed to act as the flow meter. The disadvantage then is the need to provide energy to move the rotor, and this resistance to flow may be intolerable).

Where flow is established and reasonably steady, the blades need not be close fitting as some slip is allowed. The essential features of a turbine flow meter is a freely spinning turbine that couples closely to the flow, a flow straightener preceding it to avoid errors due to already rotating flows, and a non-contacting sensor to detect turbine rotation. Most flow meters use magnetic detection. A small magnet is inserted in the blade and the external sensing coil produces a pulse for each pole of the magnet passing it. Other sensors utilize capacitance/resistance changes; several designs also operate an

(Continued on page 77)

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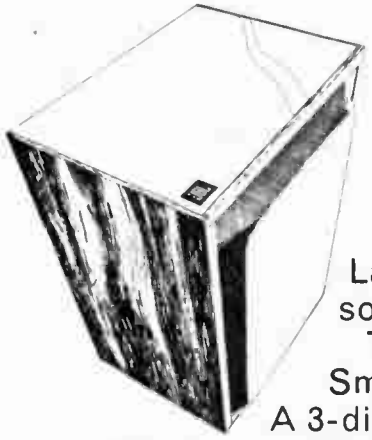

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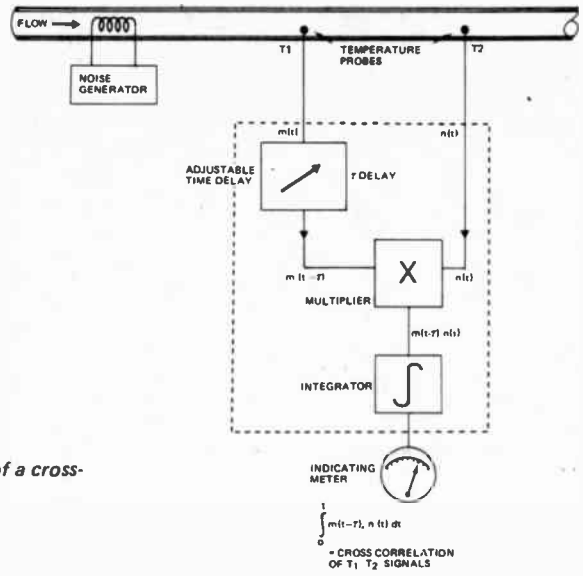

Fig. 6. Principle components of a cross-correlator thermal flow-meter.

indicating meter with a mechanical link.

Turbines can provide a linear output but because the indicated flow depends upon the (diameter)^2 they are made as a complete unit calibrated for the bore used. The output is a frequency variable pulse signal. This aids reliability and ensures compatibility with digital equipment. Such devices have been developed to measure liquids and gases, covering a range of flows of 15:1. Using different size turbines, gas flows from 1m^3/hr to 50,000m^3/hr can be measured.

In a good design, the mechanical (rotational) inertia is made small and the resistance to rotation (damping) negligible. This fact, associated with close coupling in most fluids, enables turbine meters to follow rapidly changing flows. Responses are of millisecond order so that transients and low frequency pulsating flows can be followed faithfully.

In air speed measurement, the rotating-cup anemometer (this term is usually reserved for air flow meters) works on the same principle. Shaft rotation provides signals via magnetic sensing. A recent version uses a magneto-resistor to sense the movement, as this has greater sensitivity. It has already been stressed that flow is difficult to measure accurately and tests of anemometers and more advanced instruments indicate that the rapidly changing nature of wind can lead to considerable errors in the former.

Drag-plate flow meters use a plate suspended in the stream. This is constrained by springing, for example by means of a torsion hinge, cantilever or spring-loaded lever. Its movement is monitored by a displacement transducer. A recent unit made in the National Engineering Laboratory in Britain is shown in Fig. 5. If the spring system is stiff, movements will be small but response high. The unit shown moves only 100μm and can follow pulsating flows to 100 Hz.

There are other ways to make use of the momentum of the fluid. One intriguing device uses it to alter the precession torque of a gyroscope. The liquid is piped through a loop made in a plane perpendicular to the axis of flow (that is, the fluid moves in a circle where the flywheel would normally be). The flow through the loop acts as the flywheel, producing angular momentum in the same way as a flywheel. If the loop is rotated, the gyro torque output is a measure of flow rate so the developed instrument nods the loop about a mean position to develop the torque as an ac signal which is then converted to dc form.

Another device uses two turbine blades of differing pitch that are joined together on common bearings by a torque spring coupling. They rotate in unison in the flow but as each experiences a different torque because of the blade pitches, they take up a relative angular position different to that at zero flow. Sensors at both blade positions deliver two trains of pulses. Their phase difference is a measure of mass flow.

TIMING SYSTEMS

When only a single measurement of flow rate is needed, the simplest way is to drop an identifiable marker in the stream. A ship's log is used at sea in this way to measure relative speed. Similarly, in channels or pipes a tracer can be injected. Common salt is often used in clean rivers. In polluted waters lithium salts may work. The gulp method dumps the tracer into the flow. Downstream samples are collected at known time intervals and analysed for salt concentration. Plotting values against time shows when a maximum is reached and this plot is related to flow rate. Suitable tracers are chemicals, dyes or isotopes, the latter having limited use due to health hazards.

When continuous measurement is needed, such tracers are usually impracticable, but the concept can still be used with heat or motion bursts that are generated in the fluid. Although the principle is simple, the signal levels are small and they exist in the presence of severe noise signals of the same form. The use of cross-correlation techniques has been proven capable of measuring the time delay for heat perturbations to pass between two points despite poor signal/noise ratios. As an example of this very recent method, a thermal flow meter is now explained.

Fig. 6 shows a schematic of a cross-correlator thermal flow-meter showing the major fluid and electronic components. At a convenient point in the flow is a small heater which is energized by a signal generator providing a pseudo-random noise signal. This imparts to the fluid relatively small quantities of heat in a time sequence resembling random heating. (In practice this generator is binary in nature providing only two levels of signal to the heater but in a continuing random time sequence – it is termed a pseudo-random binary sequence, P.R.B.S. generator). Down stream are two, fast-response, temperature sensors a metre or so apart, so that each receives the same thermal fluctuations but at different times. Merely examining the temperature sensor signals would reveal little more than a noise signal with no clear definition of the original input to the heater. Therefore a

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process of correlation is used to recover the buried signals.

Correlation can be visualized by considering two identical complicated optical patterns formed on film transparencies. When the two are exactly overlaid, the maximum amount of light transmission occurs. If we now misalign the patterns, the transmission attenuates rapidly as the degree of misalignment is increased. In the correlation of electrical signals the signals are time variables rather than space variables. In essence, the two signals are multiplied together and the multiplicand signal then averaged. This is repeated many times with different time delays. At a processing time-delay equal to that of the time taken for the fluctuations to travel from one probe to the next, the correlation output will peak quite sharply. In Fig. 6, m(t) and n(t) are the two temperature signals. The multiplier unit produces m(t-) .n(t) which is integrated to produce the output signal. The time-delay unit provides delay increments. In continuous signal monitoring, the delay unit is tracked to keep the cross-correlation output maximized.

Commercial correlators are available, but being general purpose instruments, they are usually expensive. Less expensive units (such as that shown in Fig. 7) can be made to suit specific cases such as this example.

Any signal that can be made to perturb the existing state of the fluid and then be detected may be used, the essential factor being that the pseudo-random signal marking the flow must retain its spatial form between the markers. In slurries and gaseous suspensions there is often no need to add a signal since the medium has inbuilt patterns due to voids or denser particles. In these cases, it is only necessary to sense the effect at two places using capacitive sensors for

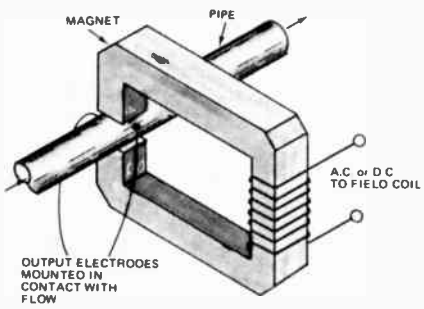

Fig. 8. Principle of the electromagnetic flow meter (an iron circuit is not always used).

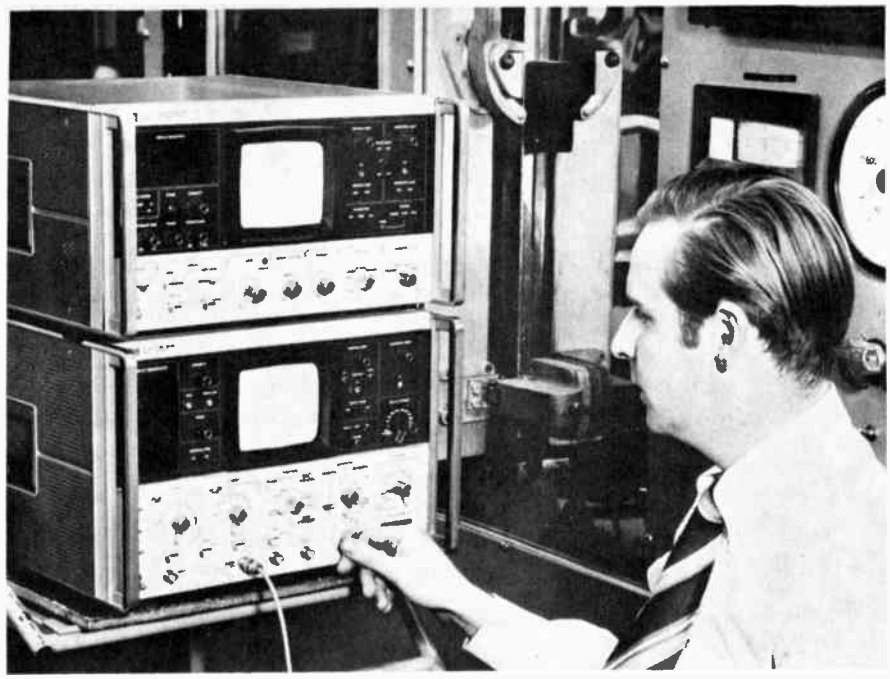

Fig. 7. Multi-purpose correlator unit (Hewlett Packard 3720A).

example. (Surface velocity is similar to flow measurement, surface irregularities providing the signal. For example, in aerial photography the aircraft ground speed is needed. One solution is to cross-correlate the appearance of the ground seen by two sensors viewing at different places along the flight path). A decade ago correlation methods were novel and in the experimental stages. Today they are used extensively as a routine procedure.

ELECTROMAGNETIC FLOW METERS

To understand the operation of electromagnetic, E.M. for short, flow meters, it is necessary to look at the findings of the 19th century scientist — Faraday. The Faraday principle states that an electrical conductor cutting a magnetic field experiences a force acting upon it that is proportional to the rate at which lines are cut. In E.M. flow transducers, use is made of the voltage generated when a field is cut by a current carrying conductor. Referring to Fig. 8, the coil magnetizes the pole piece and the liquid (the conductor) moves through the field produced in the air gap of the iron. Some E.M. flow meters use two coils laid on the pipe walls. Electrodes are placed at the positions shown for that is where the generated voltage appears. Regardless of the state of the flow, the method indicates accurately for it relies on the bulk electrical and magnetic properties of the fluid in a given volume.

When electrolysis problems might occur, the field is excited with ac, either from mains excitation using a transformer, or from an inbuilt signal source as shown in the schematic of a flow meter in Fig. 8.

E.M. meters have found use in the measurement of the flow of liquid sodium, saline solutions, seawater, blood, mercury, electrolytes such as plating solutions and, of course, water. A general guide is that the conductivity of the fluid must be greater than 10^{-7} mho/cm^3 for satisfactory signal generation. Tap water has a conductivity of about 2 10^{-4} mho/cm^3

The design of the coil and electrode shape is important. The field produced should be at least three pipe diameters in length so that the electrical shunting conductivity of the fluid just outside the field boundaries is made insignificant. The pipe of the meter must be non-magnetic — and have insulated readout electrodes (plastic is an obvious choice). If possible, the pipes either side of the meter should be non-magnetic and insulating for a short distance each way. In precision installations, the meter should be calibrated. Signal levels are small (order of millivolts) but the use of ac achieves good signal/noise ratios as the thermoelectric and electro-chemical potentials are not amplified in the detection equipment.

E.M. flow meters have been commercially available since 1950. Ranges available cover 3mm to 2000mm diameter pipes. The smooth bore design makes them suitable for slurries, pastes and liquids having solids in suspension.

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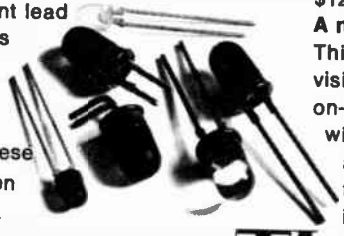

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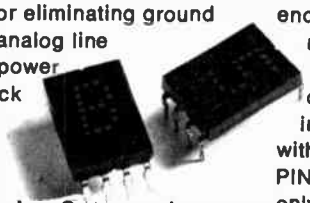

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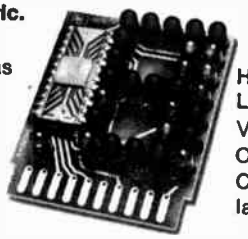

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TRANSDUCERS IN MEASUREMENT AND CONTROL

ENERGY BALANCE DEVICES

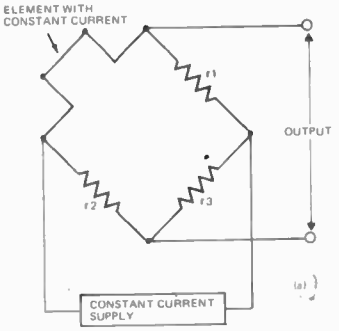
Hot wire or hot film anemometers consist of a fine resistance element suspended so as to make good contact with the gas flow. The element is heated and its resistance measured in a Wheatstone bridge circuit. Convective losses from the element, due to the gas flowing over it, depend on the velocity of the flow so the temperature of the element will stabilize at a value where the energy lost to the flow equals that supplied to the sensor.

Three basic forms are in use – constant current through the element, constant temperature of the element or, less common, constant resistance ratio between two elements. In the first, a constant current is fed to the elements (see Fig. 9a), so the element temperature drops as the flow increases. Flow is measured indirectly as the resistance of the element which depends upon its temperature. The second method alters the current so as to maintain the element of a constant temperature (as shown schematically in Fig. 9b), and the current is a measure of the flow rate.

If the flow does not have a steady temperature, but fluctuates, the above methods will not be accurate since energy loss depends on gas temperature. The constant resistance-ratio method is a way to reduce temperature errors. It has two elements, each fed with a different current. Their voltage ratio is maintained constant with a feedback system where voltage is taken as a measure of the flow rate.

The elements must be small to obtain a fast response; an example is tungsten wire, 40μm in diameter. Deposited films are also used. In turbulence studies, the system response needs to be as high as 50 kHz. Hot-wire anemometers have been developed that easily cover the need – having response times of 10μs. Obviously, such delicate probes can only be used where the flow is clear of particles and contaminants that may alter the convective film coefficient and it is necessary to calibrate these devices in-situ.

The boundary-layer flow meter also makes use of heat transfer and energy balance but in a very robust way – no delicate probes are used but the gain is at the expense of response. A heating coil is wound around a thin heating pipe as shown in Fig. 10. This produces a temperature profile across the cross-section of fluid in the pipe. Fluid near the wall is the hottest because this, the boundary layer, is not moving. The temperature drop across the layer is related to its thermal conductance which, in turn, depends upon the (mass flow rate)$^{0.8}$. One probe, therefore, measures the wall temperature, the other the fluid temperature on the other side of the layer. It is not necessary to place a probe in the stream for the centre temperature can be measured up-stream before the heater. In use, the heater is adjusted to keep the temperature drop constant. In this mode, heater power level is a reasonably linear measure of mass flow rate.



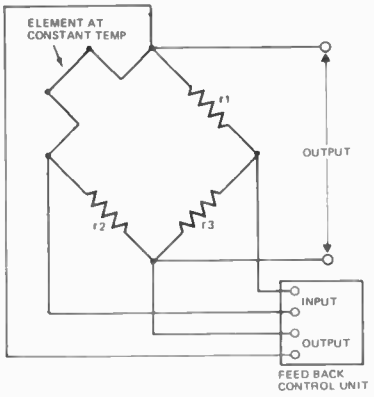


Fig. 9(a). Constant current hot-wire anemometer bridge. (b) Constant temperature operation requires feed-back to hold the element temperature constant.

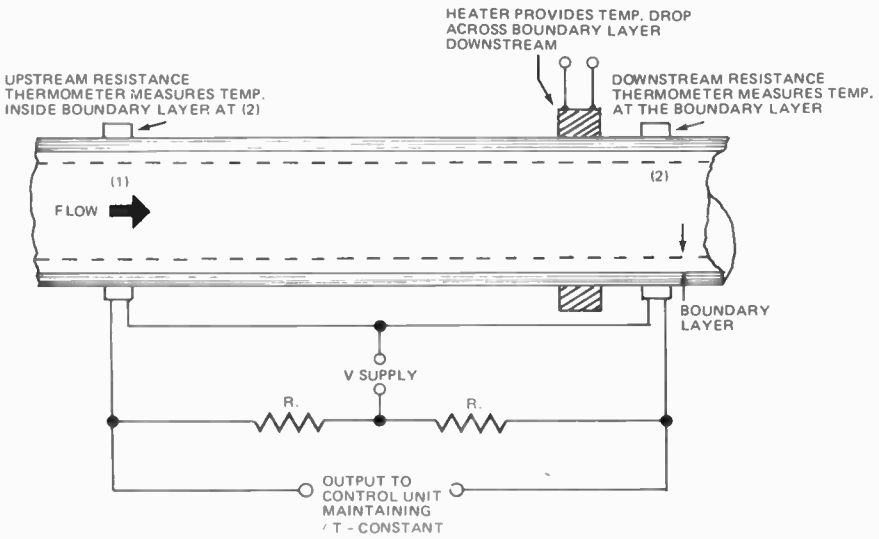


Fig. 10. Cross-section through a boundary-layer flow meter.

DOPPLER FLOW METERS

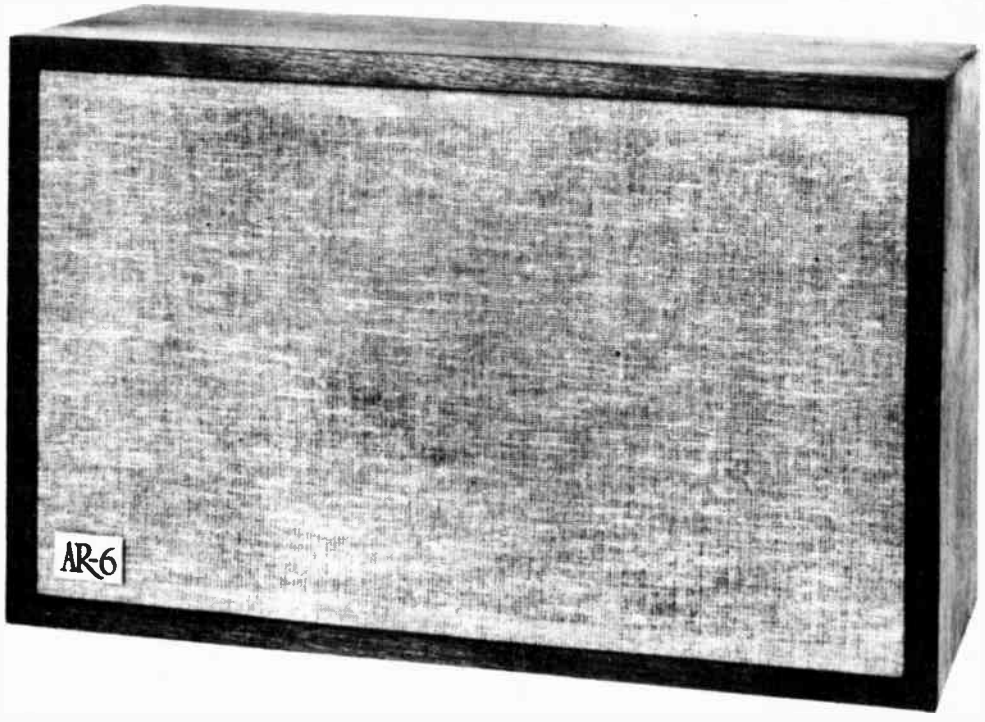
Energy radiated through a fluid in motion will reach a given point elsewhere at a later time depending upon the rate of energy propagation and the velocity of the fluid in the same direction. Another significant phenomena is that the frequency of the received signal will be altered from that of the sending source due to the doppler effect. This can provide greater resolution than straight transit-time measurement. Ultrasonic, radar and laser radiation are employed but the hardware differs in each system due to the different wavelengths.

ULTRASONICS

Piezo-electric crystals, one for transmission and one for reception, are positioned in the wall of the flow-meter aligned in direction of fluid flow. These provide radiation and detection of the acoustic pressure waves that are launched into the fluid (as shown in Fig. 11a). When the fluid is liquid, there is no problem in obtaining an efficient energy coupling, but for gases, it is a more formidable problem.

In the simplest arrangement (Fig, 11a), the upstream crystal transmits a

The AR-6 speaker system from Acoustic Research.



The least expensive speaker sold by AR (the AR-4x at $132) is also the most widely sold of all high-fidelity speakers, because it has provided maximum performance per dollar of cost. The new AR-6 offers significantly better performance for $180. It adds one-third octave of low distortion bass, and also provides superior dispersion and more uniform energy output at high frequencies. The seven inch depth of the AR-6 adapts it ideally to shelf placement, or it may be mounted directly on a wall with the fittings supplied with each speaker system.

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burst of high frequency (at typically 10 MHz) that is received down-stream. The transit-time will vary in relation to fluid velocity but this measurement also depends upon the (acoustic velocity)^2 so variations in the speed of sound greatly affect the accuracy. Furthermore, the delay time can be very small, making it hard to obtain resolution. Usually a more complex arrangement is used which has two systems acting in opposite senses, as shown in Fig. 11b. Each loop resonates because the received signal is used to send the next pulse burst (called the sing-around technique). When the fluid is stationary, the frequencies will be the same but with flow movement one frequency goes down, the other up. The beat frequency formed by comparing one with the other is a direct measure of flow velocity.

More recently developed methods make use of the frequency shift due to the doppler effect. Energy received elsewhere (or sent back) to the source will be of different frequency to the source, so frequency comparison similar to the above gives flow rate. A blood velocity ultrasonic doppler meter is shown in Fig. 11c; note the gel used acoustically to couple the crystals to the artery wall.

Before leaving ultrasonics, it is worth mentioning that ultrasonics can be used to detect leaks in pipes. Gas passing very small orifices tends to resonate in the range 30-40 kHz. Ultrasonic detectors will detect this, often at a considerable distance.

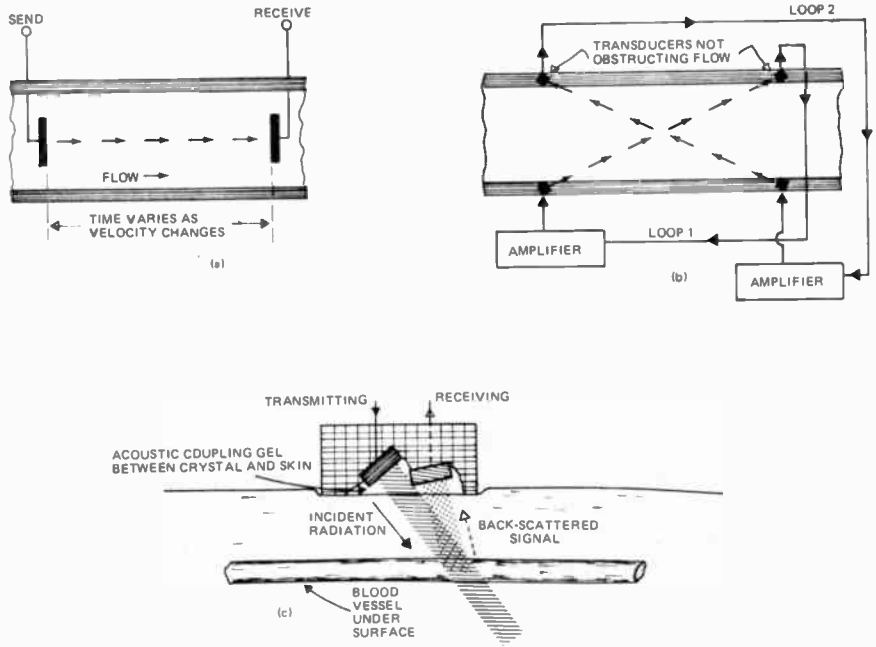


Fig. 11(a). Simple ultrasonic transit-time variation method of determing flow rate. (b) Double resonant-loop method reduces errors. (c) Ultrasonic doppler used to monitor blood flow.

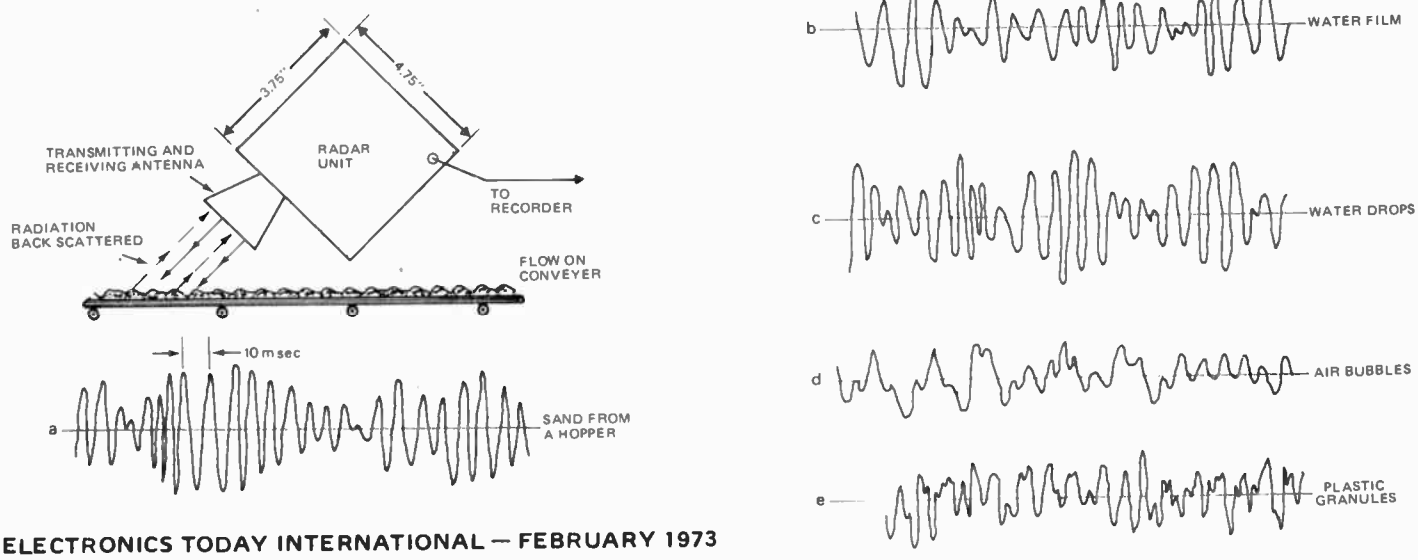
RADAR

The doppler principle has also been applied with radar sources in order to provide a frequency variable signal related to flow. The availability of miniature self-contained C.W. radar sets (such as the Royal Radar Establishment unit which is camera size and runs from batteries) has made radar doppler a reality in industry. The unit is arranged to look at the flow at a slight angle (sand, water, films, granules, liquids with air bubbles, water drop sprays and surfaces of sheet material have been measured). The same antenna acts as a radiator and receiver detecting back-scattered energy which is compared with the source frequency. The signal does not have constant amplitude nor does it exist continuously, hence reasonably sophisticated electronic equipment is needed to determine the frequency difference. Fig. 12 shows a schematic of the instrument in use – along with typical waveforms from various materials as published by the Institute of Measurement and Control. Filtering is used to improve the signal/noise ratio but it has been found that the best results are achieved by using a plastic zone plate (a disk having annular rings turned in it) between the instrument and the surface, rather than using electronic filters after the detector.

LASER VELOCIMETERS

One of the applications of laser sources is for measuring velocity with great accuracy and large dynamic

Fig. 12. Doppler radar unit compares reflected signal and source frequency to provide frequency variable signal related to flow rate. Waveforms from a number of materials are shown.



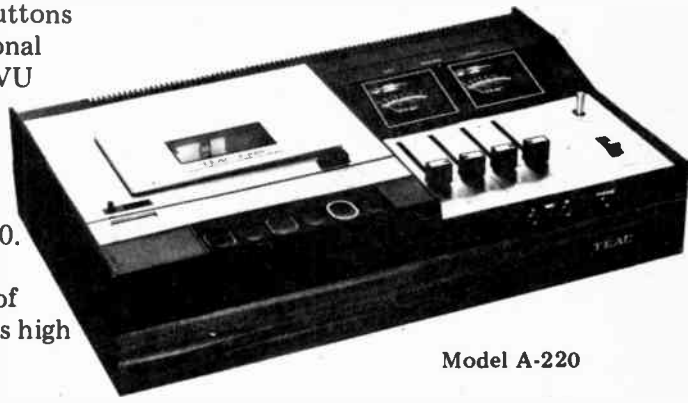
TEAC brings you the consummate in stereo cassette decks.

Here are three that sum up the best of TEAC technology.

Common to them all is a transport and hysteresis-synchronous drive motor so precise and fool-proof that they can hold their own with some of the best open-reel types. Beyond this, the differences begin. Each model has a package of add-ons for your particular needs.

Model A-210

If all you need is a basic superior deck that can economically record and playback on conventional tape within a frequency response range of 30-12,500Hz, you'll want to look into the A-210. It's outer rotor drive motor holds wow and flutter down to a negligible 0.15%. Separate stop and eject buttons. Low-noise solid-state electronics. Contoured fingertip-control pushbuttons for all operational modes. Large VU meters. Sliding scale record-playback level controls. Standard phone jacks for professional-style 600-ohm mikes and 8-ohm headsets. Strobe-type running light.

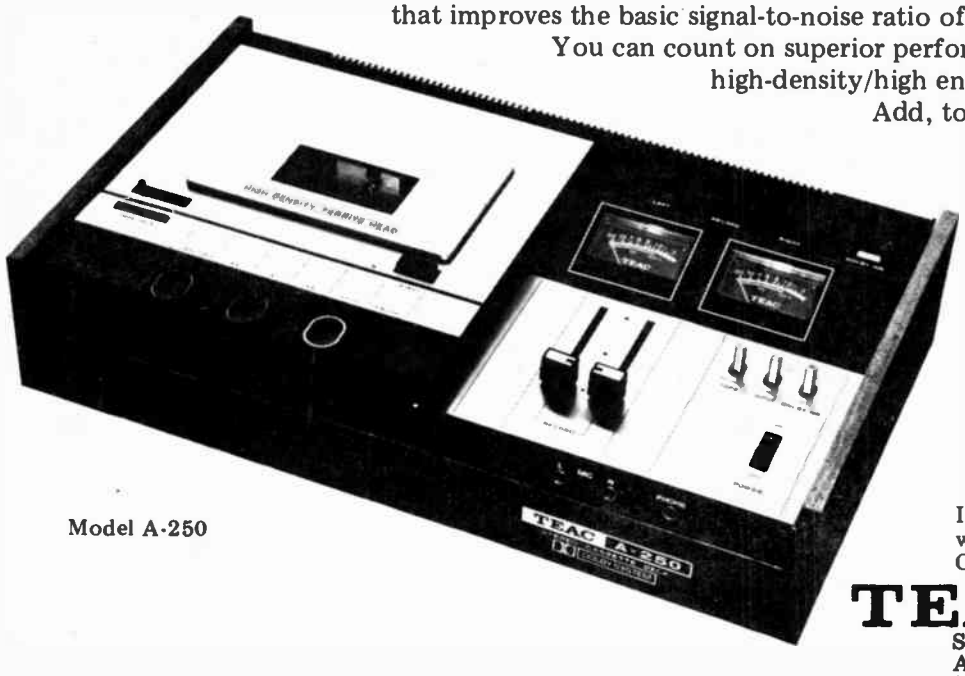


Model A-220

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

But if you're looking for the definitive Dolby deck with everything you need for near-professional operation, only the A-250 will do. It has TEAC's high-density ferrite heads. These "brown jewels" are so extraordinarily durable that we warranty them for the original owner's lifetime. Add to these a Type B Dolby System that improves the basic signal-to-noise ratio of the A-250 by an additional 10 dB. You can count on superior performance from conventional, high-density/high energy, and chromium dioxide tapes. Add, too, the large expanded-scale VU meters for distortion-free recording at optimum levels and signal-to-noise ratios.

What it all adds up to is that each TEAC cassette deck is the finest available for your particular needs — whatever they are.



Model A-250

If you'd like to know more write to us for the TEAC Catalogue, price list and franchised dealer list.

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AMI 144/R

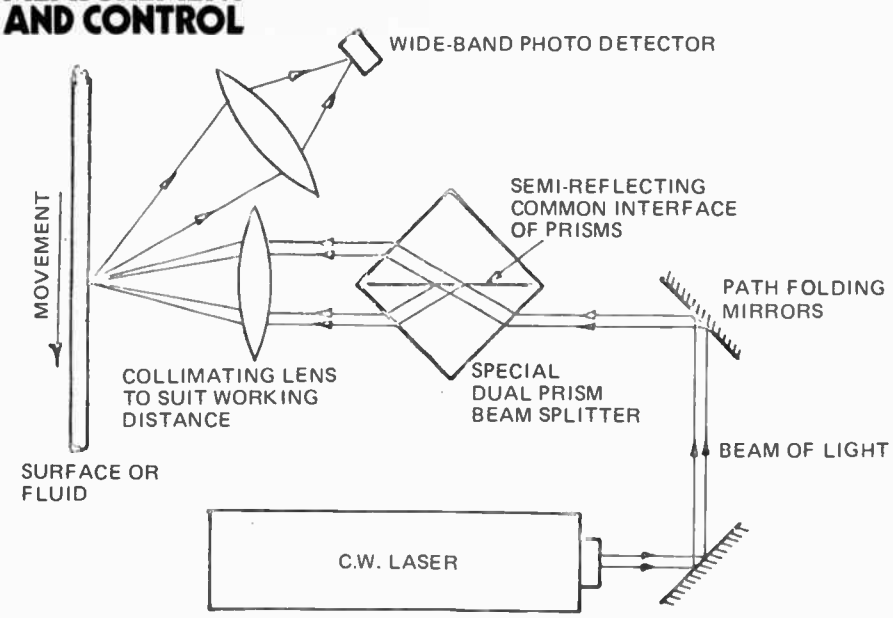


Fig. 13. Laser velocimeter. The laser beam is split to provide two coherent sources that interfere optically at point where velocity measurement is required.

range. (In principle, it is possible to monitor a range of 10^7:1). Since the early 1960's, the technique has been improved and is now commercially available (E.T.I. August, 1972). The laser beam is split (see Fig. 13), to provide two coherent sources that interfere optically at the point where velocity is to be measured. (It is necessary to make an optical comparison since interference is not possible electronically, and we do not, as yet, have detectors for such high frequencies). A sensor viewing this point sees a small circular fringe pattern that varies in amplitude as scattering changes. If the medium is moving across the field of view, the sensor detects passing fringes and produces short bursts of signal. The period of the cycles in a burst is a measure of the velocity. Extensive electronic processing is needed to produce accurate flow measurements on such vague signals. The main advantage of laser flow meters is that the velocity of a volume of fluid only $10^{-3}mm^3$ is viewed. The method is most useful in turbulence and profile studies. It is essential that some, but not many, scattering particles exist to provide a signal for the detector. Often air bubbles or a colloidal solid are injected to enhance the signal strength.

MISCELLANEOUS METHODS

In a cryogenic flow meter, the gas is made to flow through a thin flexible mesh held across the stream and parallel to an insulated electrode. As the mass flow velocity increases, the mesh is pushed closer to the electrode, changing the capacitance between the two. This is used to alter the frequency of an oscillator providing a frequency output form of signal.

(Continued on page 89)

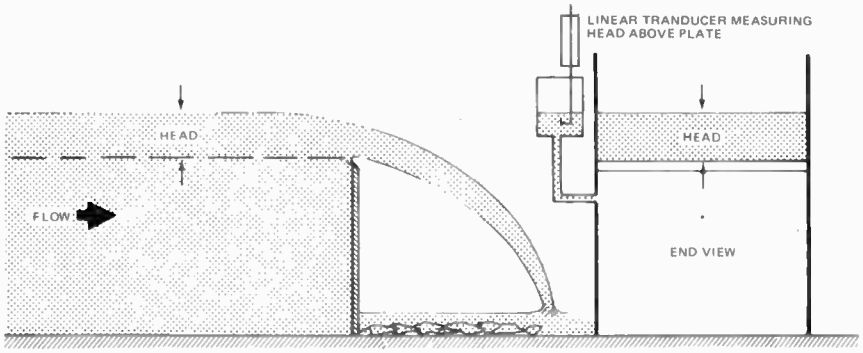


Fig. 14. This technique may be used to measure large volume flow in open channels.

Laser communication through the atmosphere

Laser beams may be used for intra-city communications.

ALTHOUGH communications engineers have already made it possible for several tens of thousands of telephone calls to be carried via coaxial cable, the search for new, even more efficient transmission media is continuing in view of the exponential growth of information flow.

The strong focusing properties, the high degree of security against interception and the wide available bandwidth of the laser beam render it potentially important for communication purposes. Scientists from Siemens Aktiengesellschaft Research Laboratories are investigating the possibilities of such a system over a 5.4km long path between the Munich districts of Giesing and Obersendling, in particular the effect of atmospheric conditions on laser-beam communications.

The CO_2 laser being used in the investigations emits infrared radiation at a wavelength of 10.6um at an output power of 5 W.

At the beginning of the experiments the use of a helium-neon laser was considered, but it has since been confirmed that the invisible infrared beam is considerably less susceptible to atmospheric influence than the visible helium-neon laser beam.

Nevertheless, even the CO_2 laser beam is subject to some perturbing effects: absorption by water vapour and carbon dioxide in the air, light scattering by minute particles of water and dust and atmospheric turbulence created by side winds and solar irradiation attenuate the laser beam, render it more diffuse, displace it and cause its intensity to fluctuate. Despite this, communication via a CO_2 laser beam is still possible in heavy mist and moderate rain, fog and snow.

The use of the laser in the communications field is thus full of promise since, in view of its very high frequency (28.3 THz for the CO_2 laser) it offers the possibility of large channel capacities for telephone calls and radio and television broadcasts. Laser transmission through the atmosphere has considerable potential use in earth-satellite links and short-range relay links between tall buildings in large towns and cities.

The optical transmission of information could also be of interest in connection with the introduction of videotelephony, which requires a bandwidth of 1 MHz and thus poses extremely complex transmission problems.

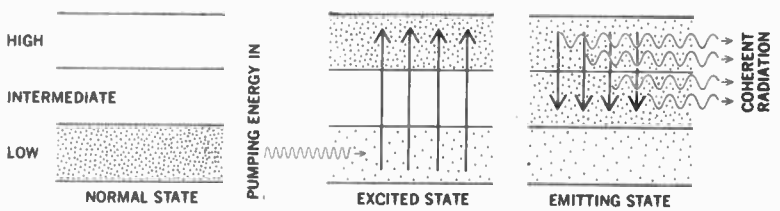
Finally, an application in the field of high-speed data transmission between computers and data centres is coming to the fore: the data could be sorted while the atmospheric channel is "closed" and retransmitted at high speed (data dumping) when the atmospheric channel is "open".

At the terminal stations of the 5.4km long trial path between the Siemens locations in Hofmannstrasse and St. Martinstrasse, the optical equipment consists of Cassegrainian telescopes, which have a concave primary mirror of 35 cm diameter and a convex secondary mirror of 3.2 cm diameter set 180 cm apart. After passing through a hole in the centre of the primary mirror, the modulated laser beam strikes the secondary mirror, which reflects it and causes it to diverge. The beam then travels to the primary mirror, at which it is again reflected before it emerges from the telescope. The incoming laser beam takes the reverse path through the telescope. The actual laser transmitter with the modulation equipment, or a detector for evaluating the incoming signal, depending on whether the equipment is designed to function as transmitter or receiver, is situated behind the primary mirror within the optical path.

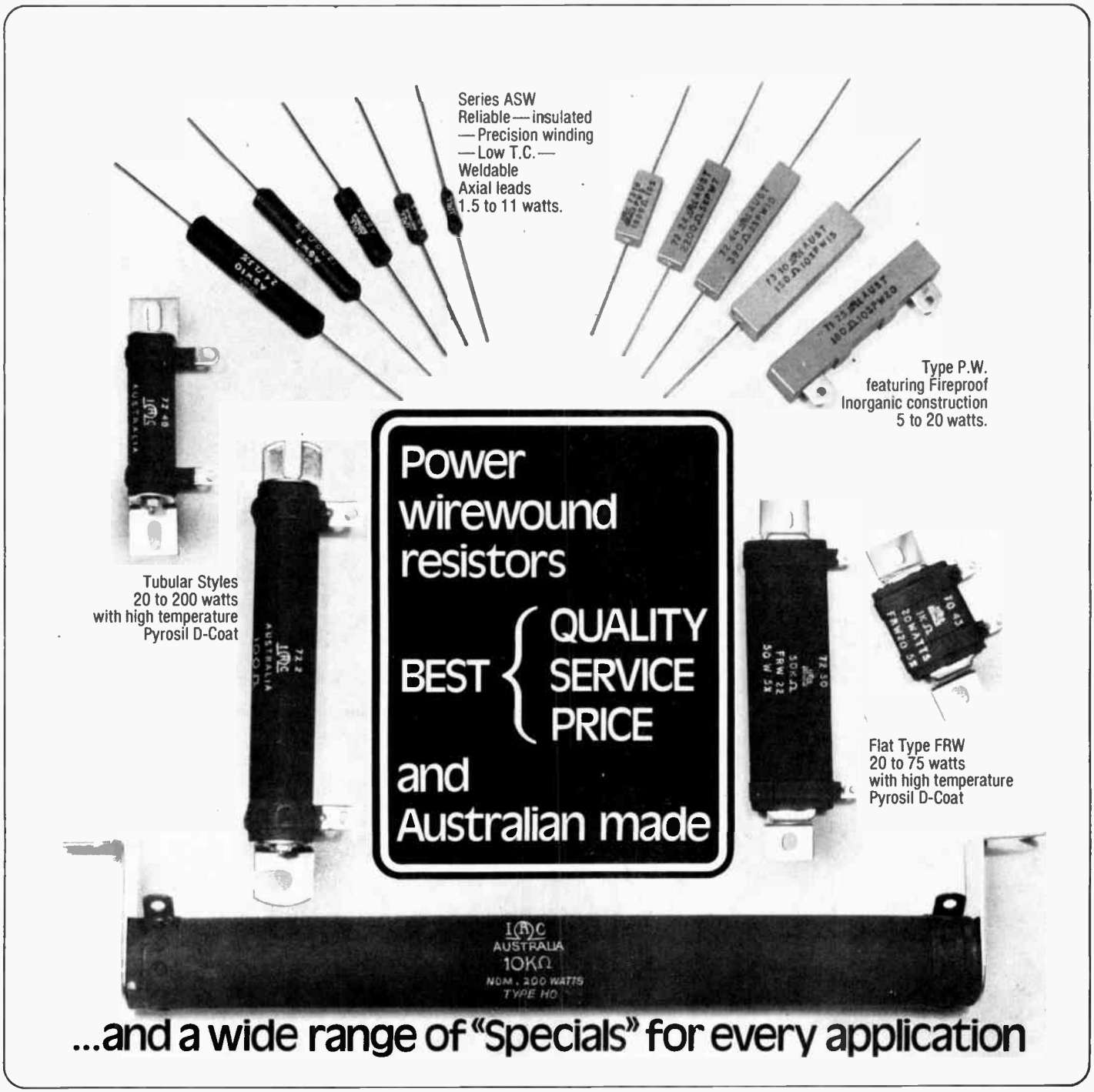
The terminal stations consist of Cassegrainian telescopes having a concave primary mirror behind which there is a laser transmitter or a detector for evaluating the incoming laser light, and a convex secondary mirror (in the foreground). The picture shows the receiving equipment.

The information to be transmitted is impressed on the CO_2 laser beam by a gallium arsenide modulating crystal. It is transparent for laser beams and converts electrical signals into intensity-modulated laser signals. At the receiving end a lens focuses the laser beam emerging from the receiving telescope into the detector. The gold doped germanium detector, which is cooled in liquid nitrogen, converts the laser signals back into electrical signals again by means of a photo-conductive effect. ●

HOW LASERS WORK



A laser is a device for amplifying electromagnetic radiation waves. When energy in the form of light or radio waves, or even from a chemical reaction, is "pumped" into the material, atoms or molecules absorb energy and jump to a higher or excited state, then spontaneously decay to an intermediate level and give up energy in the process. The energy is emitted in the form of light. Laser light has the useful property of being coherent – all waves are in step. This happens because one bit or quantum of light given off by one atom stimulates another to give off its energy in step with the first and so on. (Laser stands for light amplification by stimulated emission of radiation).



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WW72

TRANSDUCERS IN MEASUREMENT AND CONTROL

(Continued from page 85)

When large volumes of liquid move in open channels, flow can be monitored by lowering a flow meter into the stream, but there is a simpler way to permanent installations. Theoretical considerations of the shape of flow across plates or weirs leads to equations that relate flow rate to the shape of obstruction, fluid constants and height of water above the plate. This is the same concept as orifice plates, etc. but the obstruction is a continuous circle. The relationship is not linear (quantity depends on height $^{3/2}$) and shape is vital. Standards are available so that channels built to specification (one is shown in Fig. 14), can be made that give a known calibration. A float is arranged to operate a linear or rotary displacement transducer. Plates and weirs can also provide differential pressures.

The oscillating-fluid flow meter is the last to be discussed. If fluid passes through a cavity of the correct design, it will oscillate at a frequency related to velocity (and temperature – remember the fluidic temperature sensor). Oscillation is induced into the stream entering the flowmeter by passing the fluid through vanes arranged to impart a swirl inside the cavity. Oscillation frequency is detected by monitoring the fluid temperature at a point in one commercial unit. This method has a fast response – 1000 Hz is claimed and is linear to about 1% of chosen full-scale range. It operates both with gases and liquids providing they are homogenous and the cavity is designed to suit the fluid to be used. ●

FURTHER READING:

"Handbook of transducers for electronic measuring systems", H. N. Norton, Prentice-Hall, 1969.

"Measurement systems: application and design", E. O. Doeblin, McGraw-Hill, 1966.

"Symposium on the measurement of pulsating flows", April 1970, Institute of Measurement and Control, London.

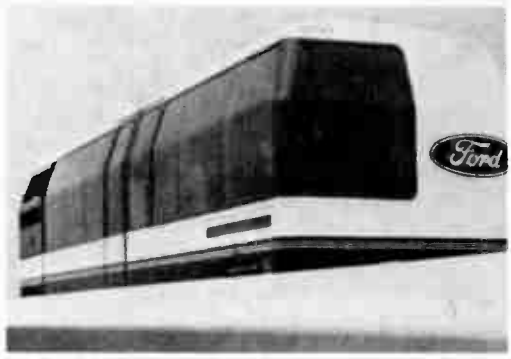
Extensive bibliography (to May, 1972) of blood flow measurements available from Parks Electronics Laboratory, Beaverton, Oregon, U.S.A.

"Fluid mechanics", V. L. Streeter, McGraw-Hill, 1958. (Background text for basics of fluid flow).

"Symposium on measurement and process identification by correlation and special techniques" January 1973, Institute of Measurement and Control, London.

CARS– FUTURE SHOCK?

(Continued from page 23)



In USA, Ford have developed this electrically propelled, computer controlled transport system.

passenger enters an individual module, programs his destination and is then taken directly to that destination. Speed and switching are controlled by computer, which also controls distances between vehicles. The result is personal transportation from origin to destination but which at peak travelling times may be shared with other people going to the same destination.

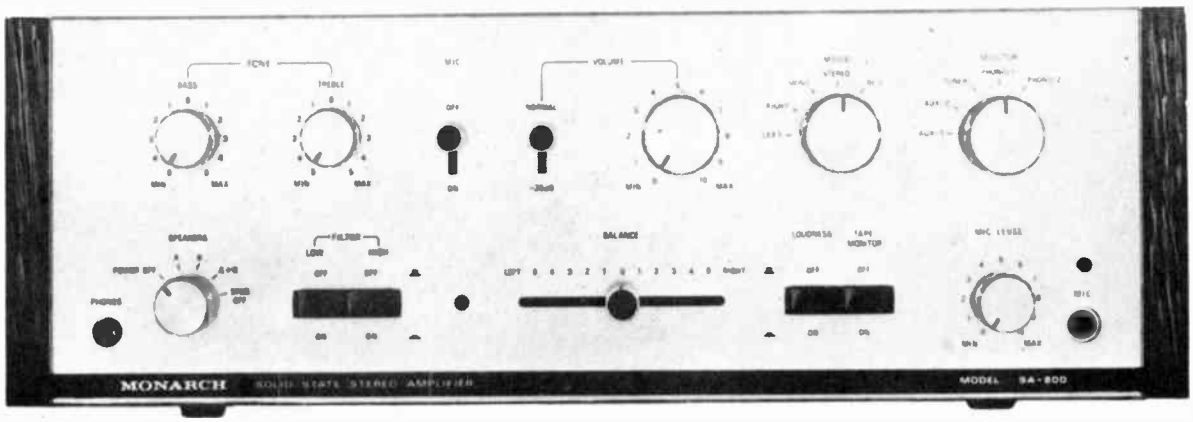
It is significant that one of the many major organisations actively developing PRT systems is the Ford motor company.

Concepts such as these may seem unreal in light of the relatively minor role that electronics plays in present day automobiles.

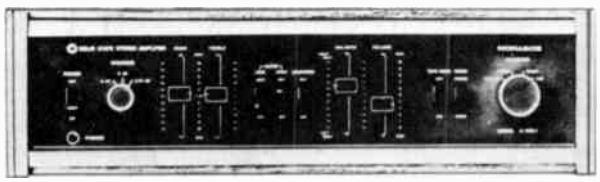
But in automobile engineering – as in so many other fields – we are faced with problems of ever-increasing magnitude that can only satisfactorily be solved by the use of electronic and related technologies. It seems probable that they will be. ●

Central light source is divided by 27-way distributor and fibre-optic light guides to provide individual instrument illumination.

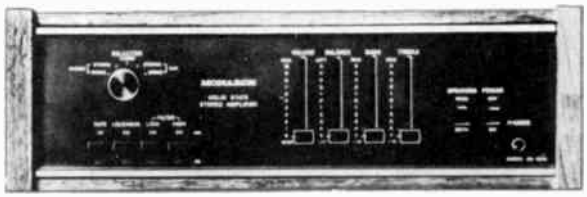
Three Kings



MONARCH SA 800 (80 watts RMS)
Recommended retail price $240



MONARCH SA 5001 (60 watts RMS)
Recommended retail price $189



MONARCH SA 600 (34 watts RMS)
Recommended retail price $139

Three amplifiers that stand head and shoulders above the rest. Because in the ratio of Power-to-Performance-to-Cash each Monarch amplifier gives more power, more performance for less money than any other amp in its class. No wonder Monarch is king as Australia's largest selling amplifier.

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We introduce the BASF jam proof cassette.

The first cassette actually guaranteed against jamming or we'll replace it at any time, free of charge.

Every BASF Cassette is fitted with a special kind of tape transport system that guides the tape through the cassette without it ever snagging or sticking. It's called "Special Mechanics" and only BASF Cassettes have it.

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Special Mechanics tape transport makes the super sensitivity and super faithful reproduction of our tapes all worthwhile. Choose BASF LH (Low Noise, High Output)—the finest ferric oxide cassette tape on the market. Or pay a little more for the ultimate—BASF Chromium Dioxide—its extended dynamic range, highest output and lowest noise level, plus the additional reward of minimal headware are the qualities you'll appreciate.

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BA2279

AMATEUR RADIO

THE STATE OF THE ART

Roger Harrison VK2ZTB

In this column last month, mention was made of 144 MHz work between Adelaide and Albany, W.A. Attempts on 432 MHz had been made over this path several times when conditions on 144 MHz were good, but to date only weak CW had been heard from VK5ZK, one way.

On 11th December, two metre conditions between Adelaide and Albany were excellent. Kerry Adams, VK5SU at Ceduna, S.A. (approximately 320 miles west of Adelaide) worked into Adelaide and Albany with very strong signals, although Kerry's home-made 144 MHz transmitter has a power output of only 20 watts. Signals between Tony Sterling, VK5ZDY (Adelaide) and Wally Green, VK6WG (Albany), were so good on 144 MHz that Tony shifted to 432 MHz and was immediately being copied in Albany. Wally also moved to 432 MHz and the contact was completed on that band. The path length is in excess of 1,100 miles. This work culminates 25 years of work by amateurs in Western Australia. The grand old man of V.H.F. in Albany, Rollo, VK6BO, first worked across the Bight on 144 MHz via tropo in 1951, but this feat was not repeated until the 1960's. Regular two-way work became more common with the advent of beacon transmitters at both ends of the path, and persistent scheduling by stations in Adelaide and Albany. Wally, VK6WG and Rollo VK6BO pioneered V.H.F. tropo work between Perth, Albany and other towns, in the fifties, using equipment far inferior to that available today.

ANTARCTICA TO AUSTRALIA ON 52 MHz

Six metre workers have been rewarded with transequatorial openings to Japan in November and many sporadic E layer contacts interstate and with New Zealand. T.E. openings from Japan have been observed in Queensland, New South Wales, Victoria and as far south as Tasmania several times in November and early December, which is later than expected. T.E. propagation is usually observed only during equinoxes in April and September.

For some years, 52 MHz beacons have been installed by the Ionospheric Prediction Service at bases in Antarctica and Macquarie Island. These beacons have occasionally been heard in Australia, but no contact was ever made with amateurs (yes, there are some!) in Antarctica. Several times in early December, VKØWI, a beacon on Macquarie Island was heard in the Eastern States, sometimes for hours on end, but no activity was observed until 10th December, when VKØWW and VKØZVS appeared on 52.160 MHz SSB. These gentlemen worked hundreds of stations in all states except Western Australia then, and during subsequent openings. This was the first time two way work was accomplished between VKØ and the mainland on six metres. On the evening of 10th December, the 53.200 MHz (VKØGR) at Casey, Antarctica was heard for several hours in Sydney. The path length exceeds 3,000 miles.

At the time of writing, the sporadic E DX season appears to be the best for many years, but then there has never been so much high power SSB equipment used on 52 MHz as has this year.

Finally from the United States, there is news of the first EME (moonbounce) work on six metres. W5SXD/5 and K5WVX were the first stations to contact each other via the EME using 1 kilowatt transmitters and 48 element antennas at each end. Forty eight elements is a lot of antenna on six metres when one considers that a half-wave dipole on this band is over 9 feet long. ●

SPECIFICATIONS FOR OSCAR – VI

(a) Orbit Details
Period 115 minutes; inclination 99° to the equator (retrograde), height 1100 km circular. Midday crossing (local solar time).

(b) Equipment
(i) Linear translator.
Input – 145.950 MHz ±kHz
Output – 29.500 MHz ±50 kHz
Receiver sensitivity – 120 dBM.
Transmitter – maximum power output 1.3 W PEP.
Modes of Translation – A_1 A_3 A_3A, F_3 F.S.K., S.S.T.V.
also CW beacon 29.450 MHz
(ii) 70 CM beacon transmitter
Frequency – 435.100 MHz
Power – 0.75 Watt.
Modulation – Telemetry, CW 20 w.p.m. or 13 w.p.m. – ground command selection – Codestore modulation, 13 w.p.m.
Telemetry – 24 channels, to monitor essential functions.
Codestore – 1024 bits, A_1 mode, ground programmable (normally loaded with orbital or any other pertinent information for replay during any orbit).

Command – 21 channels to central all housekeeping and control functions aboard the spacecraft. Commands are in F_3 ± 7.5 kHz deviations in form of digital code.

On board power supply – Ni.Cd batteries charged by on-board solar cells, average power four watts at 28 volts.

Lifetime – Design lifetime is one year with all components manufactured to military specifications.
The beacon transmitter and command decoder were built in Australia.

AUDIO NEWS

PIEZOELECTRIC TWEETER

A unique tweeter utilizing the piezoelectric principle (in which an electrical voltage impressed across a section of suitable material causes that material to be stressed mechanically) has been developed by Motorola in the USA.

The tweeter is constructed from two oppositely polarized ceramic discs separated by a corrugated disc centre. The signal input voltage causes one disc to expand whilst the second one contracts.

Our informant tells us that the new tweeter is extremely efficient – as is the nature of piezo-electric devices in general – producing levels of 100dB or so from a 4V rms input.

The device is extremely rugged and can tolerate at least 35 volts input – hence no crossover network is required to protect the unit against overload.

Interestingly, Motorola are actively developing full-range speakers and active planar radiators utilizing this principle.

ULTIMATE CASSETTE PLAYER?

Exhibited at the recent New York hi-fi show was Concord's new Concord-Nakam Studio Z Cassette Recorder.

The new unit – which is at least three times the size of most other cassette units – has separate record and playback heads. This enables the user to monitor the tape as it is being recorded.

The units have both Dolby and DNL noise reduction systems, a peak limiter (as incorporated in the Pioneer unit reviewed on page 26 onwards this issue). Also included is a memory for automatic cueing. Price $1000 USA.

GARRARD PRODUCES MILLIONTH SP25 RECORD PLAYER

More than one million Garrard SP25 record playing units have now left the production line of the Plessey Garrard factory at Swindon, England.

To mark the production of the one millionth Garrard SP25 record playing unit, the Decca Record Company Limited has presented to Garrard an inscribed gold disc, the record industry's traditional way of commemorating the achievement of the magic million figure.

The disc was presented at the recent International Audio Fair at Olympia, London.

Mr. Geoffrey Bowden, general manager of Garrard, said: "We believe that this is the first time that production of one model of a Hi-Fi single player unit has reached the magic million mark. When the SP25 was introduced, it brought advanced design trends to the medium prices equipment market, and has without doubt proved to be the most popular unit ever produced in the audio separates field, both in the UK and overseas."

In addition to facilities for manual operation and automatic playing of single records, the SP25 has a lever type cue and pause system equipped with fluid damping for gently lowering the pick-up onto the record. The tubular low resonance aluminium pick-up arm is counterbalanced by a resiliently mounted weight, and the stylus force is adjusted by a dial-type knurled knob finely alibrated from 0-5 grammes. Bias compensation is set by a finger-tip adjustment, and the scale is calibrated to correspond with the applied stylus force.

Driven by the well-proven Garrard 4-pole induction motor, this three-speed single-play unit complies with DIn 45-500 Hi-Fi performance standards with wow and flutter claimed to be better than 0.14% rms, and rumble (relative to 1.4 cm/sec @ 100Hz) better than -46dB.

SAFETY CAR RADIO

An experimental device which automatically adjusts the volume of car radios has been developed by Ford engineers. It could make an even bigger contribution to safety and convenience than push-button car radio tuning.

Test show that motorists tend to reach forward and adjust the volume of their radios more frequently than they re-tune to a different station. As the car goes faster they increase the volume to maintain a comfortable listening level. When slowing down, for traffic lights or some other reason, the general noise level within the car drops, but the radio remains much too loud for comfort.

This can distract the driver's attention and so it was mainly for safety reasons that a research team at the Ford Research and

Engineering Centre at Dunton (Essex) looked at the problem. Although research into automatic volume control has been going on within the electronics and motor industries since the 1930s, Ford is believed to be the first to have produced a practicable solution.

The secret lies in a tiny transmitter linked to the car's speedometer. It sends a signal to a small printed circuit module in the car radio, which adjusts the radio volume up or down according to road speed. So the volume is set at a comfortable listening level at the start of the journey and it stays that way – whether at 10 mph through towns, or 70 along a motorway.

"The effect is quite remarkable," says Ford researcher Brian Pope. "We ran tests with two radios in the same car, one costing $50 and the other $175. The cheap radio had our volume control device fitted and generally gave the impression of being the better quality receiver of the two.

Mr Pope said that development work is continuing before the device is considered for production. He did not think it would add significantly to the cost of a car radio if production proves feasible.

AUDIO-VISUAL SHOWS MADE EASY

A new device called the "Pulsync" has now been released by Convoy International Pty. Ltd.

The Pulsync may be connected to any type of stereo tape-recorder or tape-deck to synchronize the sound with a slide projector – as long as the projector has a remotely controlled magazine system.

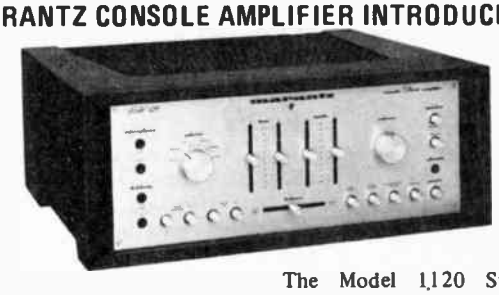
The Pulsync has been developed for use in universities and schools, and the latest model is suitable for not only educational use but also use in the home to enable professional quality sound slide shows to be produced.

The unit is mains operated (240V AC50 cycles). It is only necessary to connect the Pulsync to an existing stereo tape-recorder or Hi-Fi system or stereo cassette-recorder and to press the synchroniser button every time a slide change is desired. As the button is pressed, a pulse is recorded on the second track of the recorder and the projector changes to the next slide, meanwhile the voice and music commentary is recorded on the first track. On replay, voice and music is heard whilst the slide projector changes automatically, and exactly where the button for the slide change was pressed. There are no buzzes or pips heard on the sound track. Tapes and cassettes can be used on both sides.

The Pulsync comes complete with connector cords for coupling to stereo recorders and Hi-Fi systems. The cost complete with instructions is $73 including sales tax. Further details from: Convoy International Pty. Ltd., 1 Maclean Street, Woolloomooloo, Sydney.

AUDIO NEWS

NEW MARANTZ CONSOLE AMPLIFIER INTRODUCED



The Model 1120 Stereo Console Amplifier has been added to the new line of components by the Marantz Company, subsidiary of Superscope, Inc., announced Fred C. Tushinsky, Vice President and Director of Marketing.

The Model 1120 offers total full range RMS power 120 Watts (60 Watts per channel) with less than 0.2% total harmonic distortion. High and low noise filters operate at 9kHz and 50Hz respectively with 12dB per octave slopes.

Rear panel Preamp Outputs and Power Amp Inputs permit separate operation of the Model 1120 amp and preamp sections for convenient hookup of accessory equalizer devices.

The Model 1120's full complement of features and controls include: Slide Type Tone Controls; switching for headphones and two stereo speaker pairs; Tape Monitoring for two 3-head tape decks; Headphone Jacks; separate microphone inputs for both channels; plus rear panel inputs and outputs for virtually any companion unit.

The Model 1120 Stereo Console Amplifier is priced at A$649.00, and can be rack mounted with the optional RA-1 Rack Adaptor. A WC-1 walnut cabinet is also available.

The Marantaz Company is a subsidiary of Superscope, Inc., the sole distributor in the United States for SONY tape recorders and magnetic tape, and manufacturers and distributors of Marantz and Superscope high fidelity stereo components.

AUDIO TRADE MAGAZINE

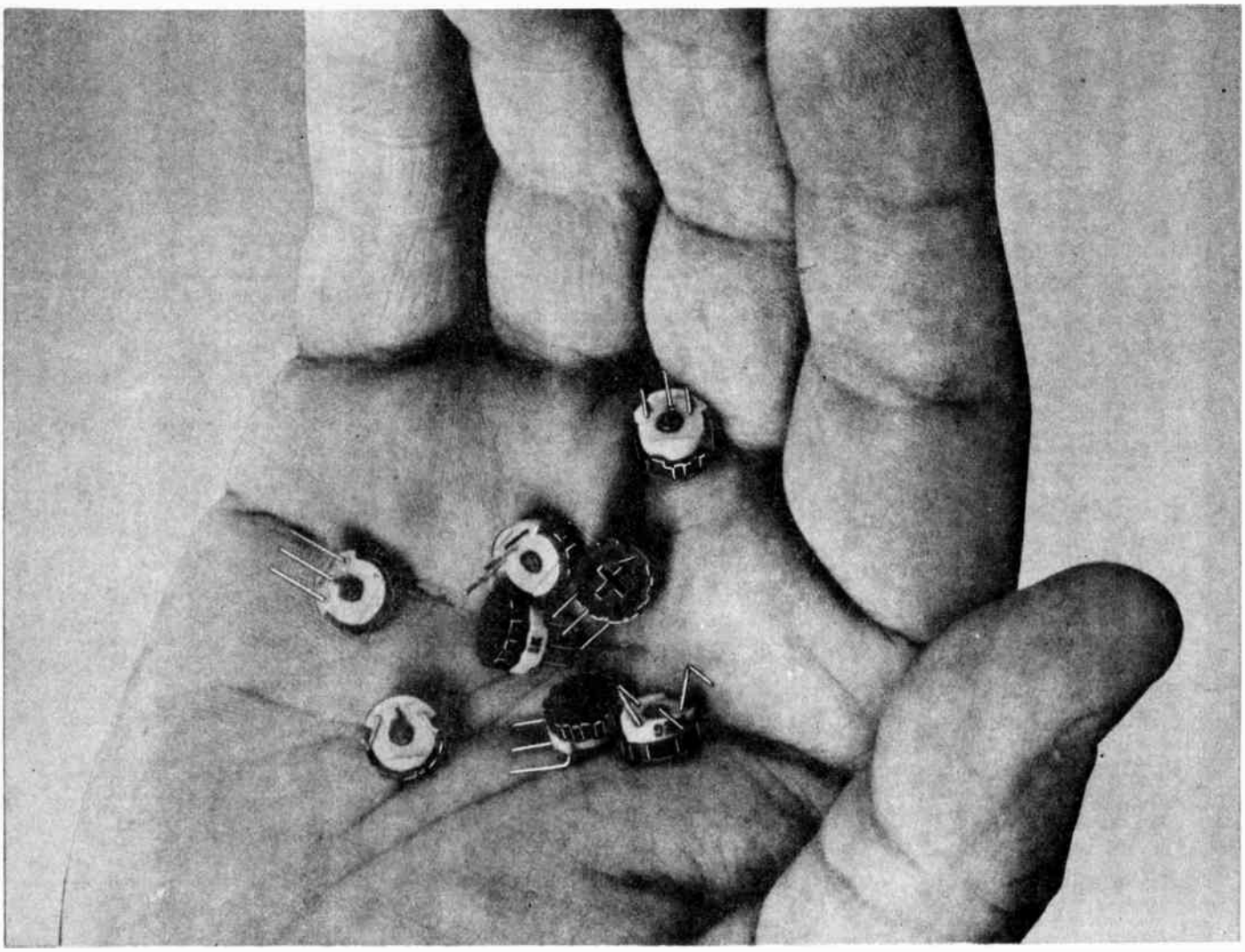
A new magazine specifically intended for the Australian and New Zealand audio trade has been launched by Modern Magazines, publishers of Electronics Today International.

The new magazine called 'AUDIO TRADER' is intended to bridge the communications gap between the audio manufacturer and importer and their retailers. One of the magazines functions will be to provide a medium of instruction and assistance to salesmen of audio equipment.

The first issue, to be produced early in the new year, will include Australian and overseas news, trade views on current topics, new products information, technical articles and features directed to the shop-floor, marketing and sales oriented columns and a variety of other salient trade information.

AUDIO TRADER will have a controlled circulation – being sent free to all Australian audio dealers. Collyn Rivers is Editorial Director, Wendy Roy is Editor, and Howard Jenkins is Advertising Manager.

For further information contact Wendy Roy, Audio Trader, 21-23 Bathurst St., Sydney. 2000.



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

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

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

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

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

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

Beckman®

WF WARBURTON FRANKI

● ADELAIDE 56-7333 ● BRISBANE 52-7255 ● HOBART 23-1841
● MELBOURNE 69-0151 ● PERTH 61-8688 ● SYDNEY 648-1711

WF2.0372

BUY STATE OF THE ART SOLID STATE COMPONENTS— Direct from the United States!

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

DATA SHEETS ARE PROVIDED FOR EACH ITEM PURCHASED

DIGITAL INTEGRATED CIRCUITS (dual in line package)

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

Send for free brochure listing hundreds of bargains.

Signetic DTL (5 volt operation) dual in line

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

Signetic "Utilogic"

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

"Utilogic" dual in line package

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

LINEAR INTEGRATED CIRCUITS

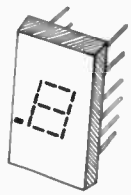
Fairchild and Signetic devices (no choice). Some of this line is not marked but it is fully tested and sold on a money-back guarantee. State first choice on package (TO-5, 8-pin dual in line, or 14-pin DIP—we will not ship flat packs).

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

LED DISPLAY

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

FEATURES:



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

ONLY $4.25

"UTILOGIC" SPECIAL

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

Complete package only $4.00

LINEAR SPECIAL

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

EACH $0.65 PACKAGE $6.00

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

LM309K—5 volt regulator

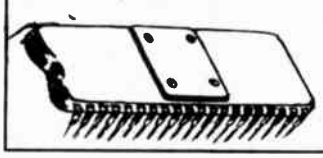
This TO-3 device is a complete regulator on a chip. The 309 is virtually blowout proof, it is designed to shut itself off with overload of current drain or over temperature operation. Input voltage (DC) can range from 10 to 30 volts and the output will be five volts (tolerance is worst case TTL requirement)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

EACH $2.50
FIVE for $10.00

LSI—CALCULATOR ON A CHIP

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

Complete with data, $14.95



Data only $1.00

COUNTER DISPLAY KIT—CD-2

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

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

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

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

Circuit board is .8" wide and 4¾" long. A single 5 volt power source powers both the IC's and the display tube.

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

Board only $2.50

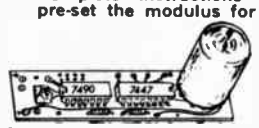
RCA DR2010 Numitron digital display tube. This incandescent five volt seven segment device provides a .6" high numeral which can be seen at a distance of 30 feet. The tube has a standard nine pin base (solderable) and a left-hand decimal point. Each $5.00

SPECIAL 5 for $20

UNIVERSAL COUNTER DISPLAY KIT CD-3

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

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



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

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

256 BIT BI-POLAR FIELD PROGRAMMABLE READ ONLY MEMORY

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

Each $10.00

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

Babylon Electronics Inc.

Post Office Box J, Carmichael, California. 95 608 U.S.A.

COMPONENT NEWS

FIRST MECL 10,000 MEMORY

A 64-bit fully address-decoded memory, which boasts almost 150 equivalent gates on its chip, has just become the first memory introduced in Motorola's MECL 10,000 high speed logic family.

The 64-bit Random Access Memory (RAM) is organized in a 16-word by a 4-bit format. Stored-data access time (address-to-output) is 10 ns typical. Read/write cycle time is typically 17.5 ns. Power consumption is only 600 mW per package, typical.

Numbered the MC10145, the new high speed RAM is packaged in a black ceramic dual-in-line case. Operation is guaranteed by Motorola to be within specifications over the broad commercial temperature range of from -30°C to +85°C. Availability is off-the-shelf.

The new memory is offered for central processor and minicomputer applications where a relatively small amount of data must be stored temporarily and retrieved rapidly. Wire-ORing and a chip-enable feature permit interconnection of multiple packages to produce larger memories: e.g. four packages, to yield a 32-word by 8-bit register file, scratch pad, cache, or buffer memory.

High Speed MECL processing and geometries, together with Motorola's proprietary double-layer metallization method, are used to produce the MECL 10,000 RAM.

Outputs of the MC10145 may be bussed, and are designed to drive as low as 50Ω.

While the new RAM is the most complex MECL 10,000 logic circuit introduced to date, other memories will be available: a 64-by-1 RAM; a 256-bit RAM; a 1024-bit PROM and RAM, etc. These additional memories are planned for introduction in various quarters of 1973.

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

SCHOTTKY DIODES FOR HIGH-VOLUME APPLICATIONS

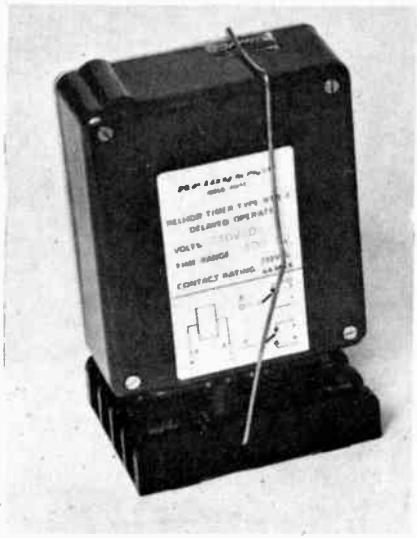
Applications for which large numbers of high frequency diodes are required, will benefit from a new, inexpensive, beam-lead diode from Hewlett-Packard. The Hewlett-Packard Model 5082-2837 is the beam-lead equivalent of HP's popular 5082-2800 Schottky Diode. It features fast switching, high breakdown voltage and low turn-on voltage. Price is 99cents for small quantities, with significantly lower prices for large volumes.

The HP 5082-2837 has expitaxial, planar passivated construction making it mechanically rugged. Its leads are coplanar, gold-plated, and are 4 mils wide by 1/2 mil thick for easy mounting. Breakdown voltage is 70 volts, reverse leakage current is 200 nanoamperes, capacitance is 2 picofarads and its effective minority carrier lifetime is 100 picoseconds maximum.

High-level detection, switching, gating, logarithmic or analog-to-digital converting, sampling or wave shaping, are among applications for the 5082-2837. At UHF frequencies, it is claimed to have 95% rectification efficiency, and its low loss and high peak-inverse-voltage make it useful in mixer and modulator applications requiring large dynamic ranges. Portable communications sets, in which small size is a paramount consideration, are among its many applications.

Further details from: Hewlett Packard Australia Pty Ltd, 22-26 Weir St., Glen Iris, Voc. 3146.

R.T.B. ESCAPEMENT TIME DELAY RELAY



A very neat and effective "Two C/O Escapement Time Delay Relay" made by the Relhor Company of Switzerland is available from Relays Pty Ltd and Relays Pty Ltd agents.

The escapement time delay relay, known as the R.T.B., is plug in and available for ac or dc operation, and as delay operate, or delay release.

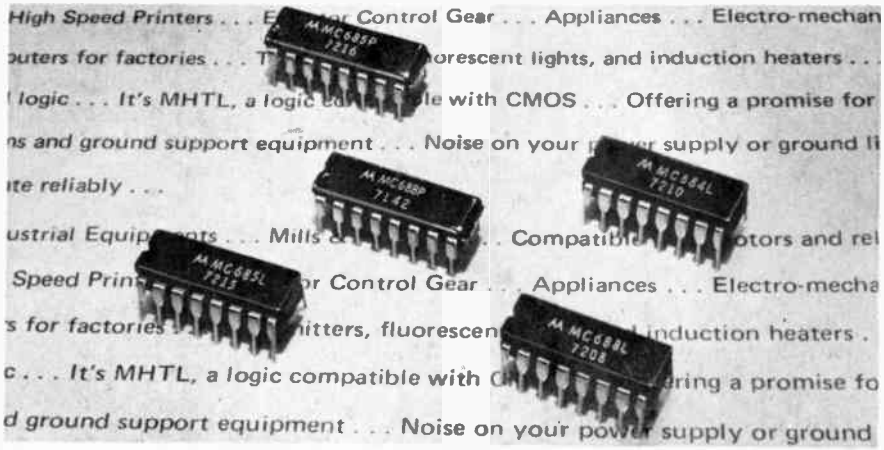
The contacts are capable of switching 4 amp at 240 volt ac or 1 amp at 60 volt dc.

The time range is adjustable between 12 sec. and 120 sec. with a claimed ± 2% (full scale) repeatability.

The R.T.B. units are 53mm wide x 70mm high and are fitted with an octal socket front connection type base.

COMPONENT NEWS

HIGH THRESHOLD LOGIC



High Threshold Logic (HTL) is a solution to many of the problems encountered when using solid-state logic circuits in electrically noisy environments.

Motorola's MHTL series has five times the resistance of classical logics (e.g. TTL) to false switching caused by spurious electrical impulses.

The MHTL Series has just begun a new period of expansion, stimulated by the rapidly increasing use of logic in demanding applications – machine tool and process controllers, computer peripherals, appliances, measuring and dispensing equipment, and so on.

Just introduced are four new MHTL devices. They are: the MC686, a 4-bit shift register (first shift register offered in MHTL Series); the MC684, a decade counter, and the MC685 binary counter (first two counters in the Series); and the MC688, a dual J-K flip-flop in a 16-pin package.

Each of the four new high threshold logic devices is available in a black plastic dual in-line package ("P" suffix to part number), or in a black ceramic dual in-line package ("L" suffix).

The standard operating temperature range for the MHTL devices is -30°C to +75°C. However, MHTL ceramic dual in-line devices are available for operation from -55°C to +125°C, and/or with high-reliability processing, on special order.

All Motorola MHTL devices operate on a +15 volt power supply. Switching threshold voltage is typically +7.5 volts, while dc noise margin is typically 6 volts.

With -15 volt operation, MHTL circuits are easy to interface to both discrete components and the relatively new CMOS logic (Motorola designation, "McMOS"). Complex CMOS circuits, in combination with MHTL designs, offer the system designer noise-immune medium and large scale circuitry to simplify large systems.

Other MHTL devices planned for introduction in the near future include multi-segment display decoders, inverters, line drivers and line receivers.

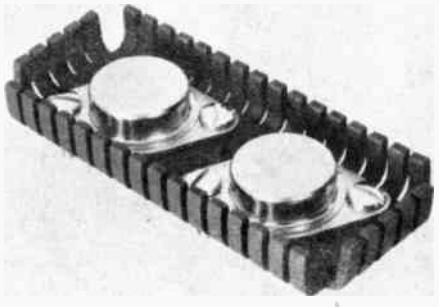
Further information from: Motorola Semiconductor Products, Suite 204, Regent House, 37-43 Alexander Street, Crows Nest, NSW 2065.

COMPACT HEAT DISSIPATOR FOR TO-3 PAIRS

Pairs of TO-3 semiconductor devices are claimed to be operable at twice the power with no increase in the case temperature rise by using a new heat dissipator developed by International Electronic Research Corporation.

The new dissipator, designated UP10–TO3-2U, requires little more height and board space than the TO-3's themselves.

The new dissipator (just 3-3/8" x 1-13/32" by 7/16") was designed for use on printed circuit boards. Its size is ideal for 3½ x 4 x 5 p-c boards which are widely used in



plug-in power supplies for high density computer applications.

In tests employing TO-3 power transistors, the semiconductors were operated at 23 watts power dissipation in still air with a case temperature rise above ambient of 120°C.

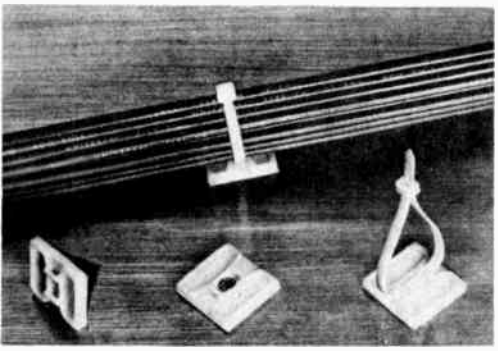
The same two TO-3's without the dissipator could be operated at only 10 watts before case rise of 120°C was reached.

The new dissipator, which features a finger design that enhances efficiency in forced air environments by creating turbulence, maintains the TO-3's 120°C case rise, while the devices are operated at a full 36 watts in 200-foot-per-minute moving air.

In addition, the new dissipator provides excellent thermal matching for the semiconductor devices.

Further details from: McMurdo (Australia) Pty. Limited, 17-21 Carinish Road, Clayton, Vic. 3168.

ADHESIVE BACKED MOUNT WIRING TIES



Panduit Corporation, Tinley Park, Illinois, announces a new Adhesive Backed Mount for securing wiring harnesses to virtually any smooth surface for light duty applications.

The new ABMS-A Mount has a pressure sensitive adhesive backing with a peel-off paper cover. The inclusion of a countersunk hole permits the mount to be used with a #6 flat-head screw or a 1/8" flat-head rivet. The result is one-hole mount which will not rotate.

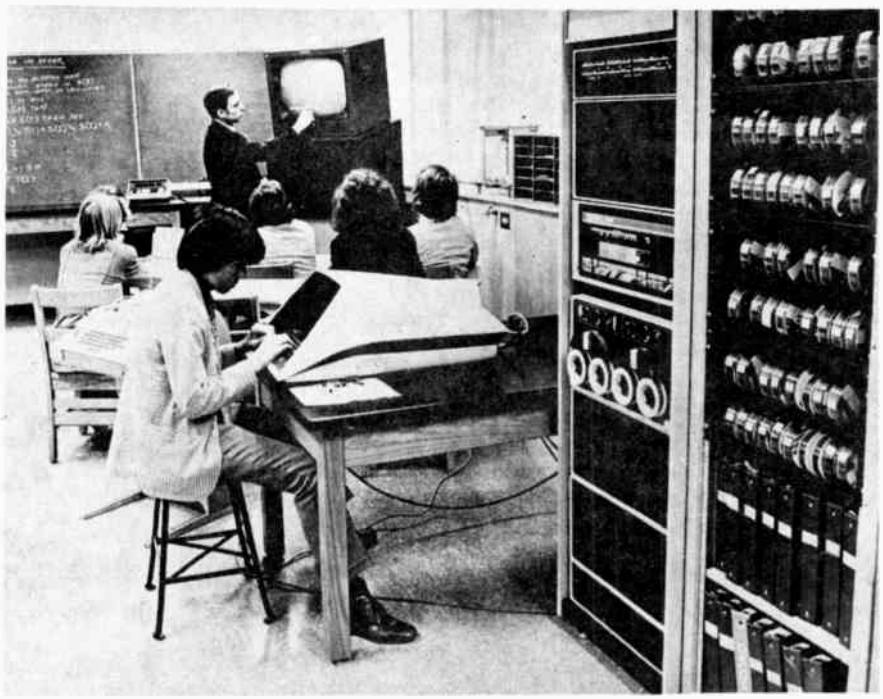
The adhesive backed mount is used in conjunction with any miniature, intermediate or standard Panduit cable tie to provide a neat, secure harness. It can be mounted to virtually any clean, dry, smooth surface and is designed to support one-quarter pound maximum weight when used without a screw or rivet.

Color is natural nylon and the mount measures 1-1/8 inches square. Delivery is from stock in ackages of 100 and 500.

Further details from: R. H. Cunningham Pty. Ltd., 493-499 Victoria Street, West Melbourne.

EQUIPMENT NEWS

CLASSROOM COMPUTER SYSTEMS



Digital Equipment has added three more members of its family of EduSystem computer systems for classroom use. The EduSystem-5 is the lowest priced, using a PDP-8/F with 4k memory and an ASR-33 teleprinter. EduSystem-5 is a super-calculator with immediate mode operation for calculations and table listings, for use by novices using simple programs in BASIC language.

EduSystem-15 includes a DECtape unit with a storage capacity of 370,000 words, with facilities for program storage on tape, program chaining and character manipulation.

EduSystem-25 is claimed to be the lowest-cost BASIC time-sharing system with on-line program and data storage available anywhere. Based on a PDP-8/E with 12k memory, the system can operate up to eight terminals either locally, or linked by telephone lines. EduSystem-25 also includes a DECtape unit with automatic controller, an ASR-33 teleprinter, a 30 character per second DECwriter, and a VT05 CRT/TV monitor system for classroom display.

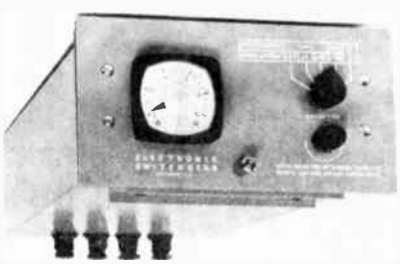
Facilities offered by EduSystem-25 include program and data file storage, BASIC-E language, alphanumeric strings, program chaining and a wide variety of language extensions to Dartmouth standard BASIC.

A single operator can also use FORTRAN, assembler language and the utility programs of OS/8, the operating system for the PDP-8 family of computers. The BASIC-E time-sharing system and OS/8 use compatible file structures, allowing data entered while time-sharing to be processed under OS/8. An expanded version of EduSystem-25 using a new 3.2 million character cartridge disk will be available in March 1973.

The three new EduSystems include software, textbooks, curriculum material and classroom guides. The programs supplied include courses in biology, chemistry, earth sciences, physics, social studies, mathematics and teacher assistance.

Further details from: Digital Equipment Australia Pty. Ltd., 75 Alexander Street, Crows Nest, NSW 2060.

ACID STRENGTH MONITOR



A new acid strength monitor is available which will measure concentrations of various types of mineral acids in the concentration range 65% to 99.5% to an accuracy of ±0.20%.

This new instrument, known as the TX6, is manufactured by Electronic Switchgear (London) Limited and is available in Australia from Kent Instruments (Australia) Pty. Limited, both member companies of the George Kent Group.

The instrument uses a specially designed electrolytic conductivity cell to measure the solution concentration. The cell is connected to the TX6 which generates a 4 to 20mA or 0 to 10mA isolated dc current signal for transmission to remotely mounted recorders, indicators, controllers or data processing devices. The TX6 monitor, which includes automatic compensation for temperature changes in the solution, can be calibrated for a variety of concentration ranges. As standard, concentration ranges selected for specific requirements in the chemical industry are available, however, other ranges can be supplied to special order.

All essential components of the TX6 are enclosed in a corrosion-resistant water-tight case and the cell is enclosed in a rugged metal body assembly. These features allow these instruments to be installed under the most arduous plant environment conditions.

Further details from: Kent Instruments (Aust.) Pty. Limited, 70 Box Rd., Caringbah, NSW.

PIPELINE METERS FOR SMALL FLOWS

A compact pipeline flow transmitter with a range of from 4.5 litres to 145 litres an hour has been developed by a British company B. Rhodes & Son, to meet the need of research and educational institutions, and of manufacturers of equipment capable of precise dosing at small flows.

The miniature 2.5 in diameter device has been designed for outstanding chemical resistance. It incorporates a PTFE rotor, sapphire bearings and a stainless steel housing and shaft, and operates on the Pelton wheel principle with the velocity of flow being measured by a jet impinging on a wheel.

In operation, the liquid impinges on the rotor, which has ceramic magnetic inserts at the tips of two of its blades. At each rotation, the inserts pass a coil which provides pulses proportional to the flow rate.

A translator converts the signal from the pick-off coil to a pulse signal that may be used to drive indicators or totalisators also available from the manufacturer. The output pulse rate is about two pulses per cubic centimeter or 2000 pulses per litre, converted to approximately 60 pulses/litre by a reed switch.

An important advantage of the equipment is that a pipeline need not be broken for routine servicing as the body of the transmitter can be left in place while the coil is unscrewed and the inner transmitter cartridge removed. The latter carries the rotor and sapphire assembly together with the transmitter jet.

For further details from: K.D.G. Instruments Pty. Ltd., Unit 14, Valetta Building, Campbell Street, Artarmon, NSW, 2064.

SMALL FREQUENCY COUNTER

A unit claimed by its manufacturers to be the world's smallest 7 digit automatic frequency counter, is manufactured in Australia by N.E.T. Nucleonics Electronics and Telecommunications Pty. Limited.

The dimensions of the instrument are:

Weight .....11.4cm (4½")
Height .....5.2cm (2")
Depth .....21.5cm (8½")
Weight .....1.6kg (3½ pounds)

N.E.T. Pty. Limited, has released two different models of these miniature frequency counters for local and overseas export markets. The company has already received orders from Europe and Japan.

The specifications of the instruments are as follows:

The Model NET-R-150 has a frequency range from dc to 32 MHz and above. Automatic display Hz, kHz and MHz with five digit resolution.

The latest Model NET-C-220 measures frequency from dc to 250 MHz with an automatic decimal point positioning and automatic display MHz in seven digit readout.

All visual display is via LED's. Both models have automatic and manual selected gate time of 1mSEC or 1SEC.

The Model NET-C-220 has an external time base input and/or output, from which a reference can be obtained, or a higher accurate standard maybe fed in. The stand clock frequency of both models, is two parts 10^{-6}. A higher accurate clock of three parts 10^{-8} is optional. This instrument has been designed mainly for outside service work, but could be used in a laboratory or for research work as well. Both models operate on ac 240V ±10% and also from 12V to 32V dc sources. The power consumption is 12 watts.

Further details from: N.E.T. Pty. Ltd., The Boulevarde, Caringbah, NSW.

WIRE WRAPPING TOOLS

Bowthorpe Australia Pty. Ltd. have been appointed sole Australian agents for the range of wire wrapping tools manufactured by the Standard Pneumatic Motor Company of Reno, Nevada.

A complete product line of tools and accessories is available including fully qualified bits and sleeves for wire sizes down to 32 AWG, and a new lightweight 230 volt electric gun.

Further details from: Bowthorpe Australia Pty. Ltd., 105 Cawarra Rd., Caringbah, NSW.

PIPE LOCATOR

An easy-to-operate unit is now available for use by tradesmen to locate pipes (copper or steel) embedded in plaster or behind plaster sheet in veneer construction.

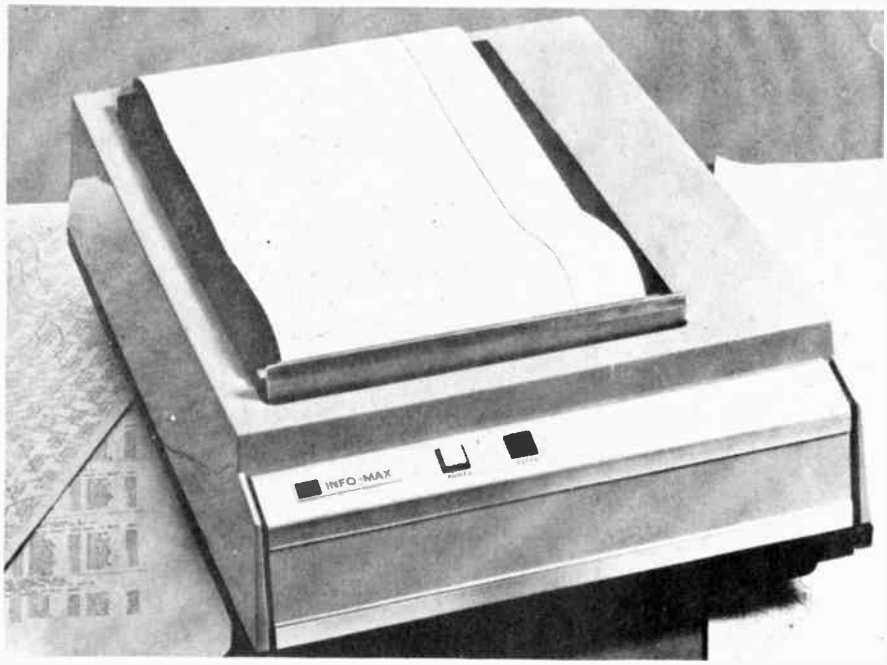
The locator is similar to a transistor radio in size, but has no controls. The action of plugging in the earpiece switches on the unit and a continuous note is heard. It is then passed over the surface to be examined. The proximity to a metal pipe causes a change in pitch of the note heard in the earpiece.

The "Spion" locator is inexpensive, reliable, and uses standard transistor batteries. It is claimed that it can pay for itself in one use by preventing damage to pipes.

Further details from: Technical & Scientific Equipment Company Proprietary Limited, GPO Box 241E, Melbourne 3001.

EQUIPMENT NEWS

COMPUTER ORIENTED ELECTROSTATIC PRINTER/PLOTTER



Houston Instruments have recently released their new Model 57 Electrostatic Printer/Plotter. This is a newly developed plotter for computer-graphics, facsimile recording, line printing, contouring and drafting.

As a printer/plotter the Model 57 gives a high quality raster plot interfaced with computer or data link, the input being either bit serial or bit parallel character serial – plots being formed of discrete .005 inch square dots spaced at .010 inch intervals.

When used as a non-impact line printer it can be again interfaced with a computer or data link. The 57 provides clear hard copy alphanumerics across the 10.24 inch paper at speeds of anything between 0 and 733 lines per minute for up to 102 characters per line.

Houston's Model 57 can give you not only these two valuable operations, but can also be used to achieve hard copy direct from CRT video inputs.

The unit is desk mounted and is extremely simple to operate and load, quiet and clean, no fixing is required for permanent records and the print is smudge proof and immediately usable.

Further information from: DC Datagraphix, DC Industries Pty. Ltd., 32 Smith Street, Collingwood, Vic. 3066.

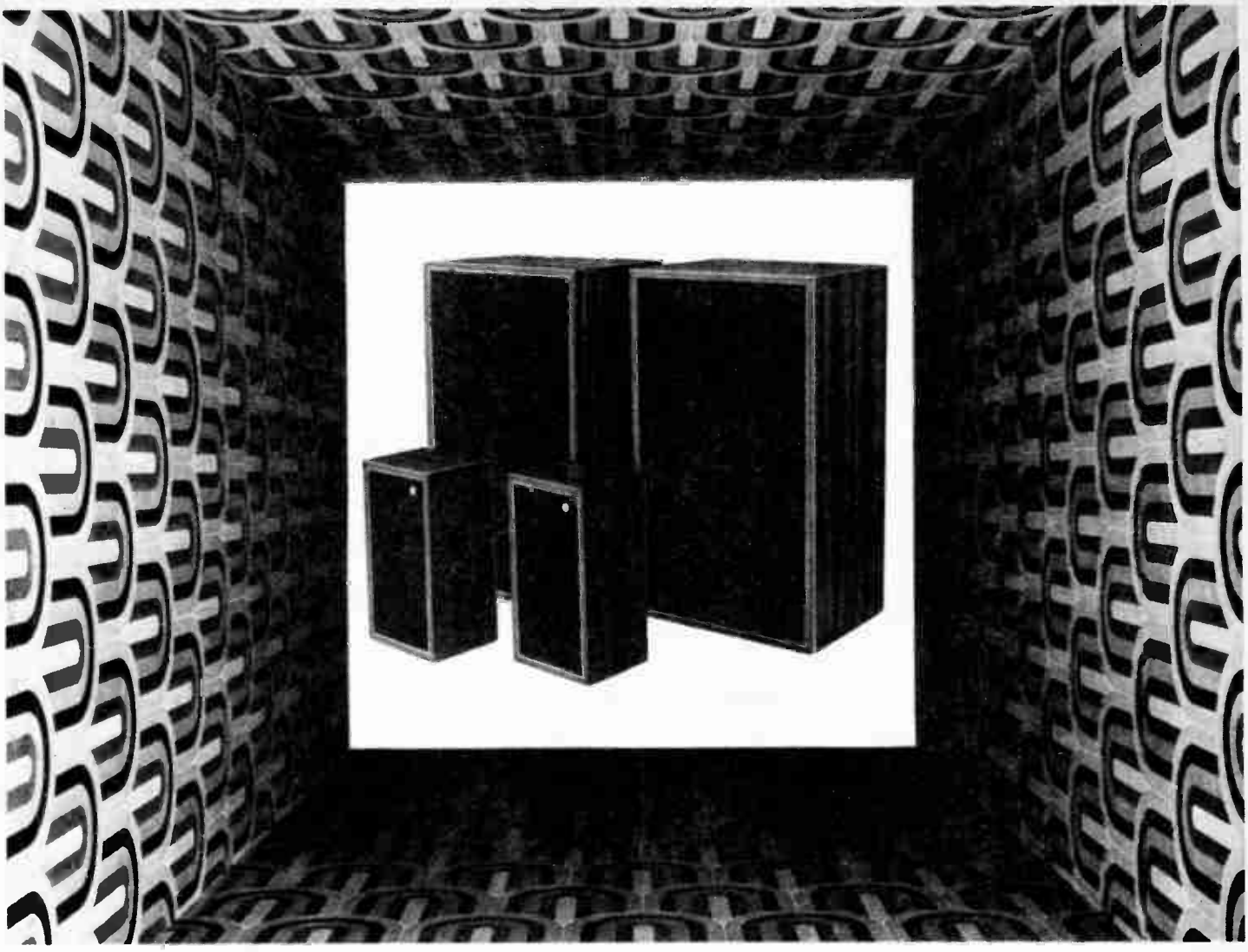
DIGITAL PANEL METERS

Schulumberger/Weston's model 1295 Digital Panel Meter offers a resolution of 1 part in 2000 with a claimed accuracy of 0.1% of reading ±1 digit.

Range, readout slope, and zero offset may be changed internally via resistor and link changes thus offering increased applications.

The instrument is well suited to industrial environments and in fact conforms to the requirements of ASAC 39 1 spec for analog type panel meters with operating temperatures of 60°C.

Dual slope integration is used. The LED display may be mounted remotely from the instrument, with either fixed or programmed decimal points.



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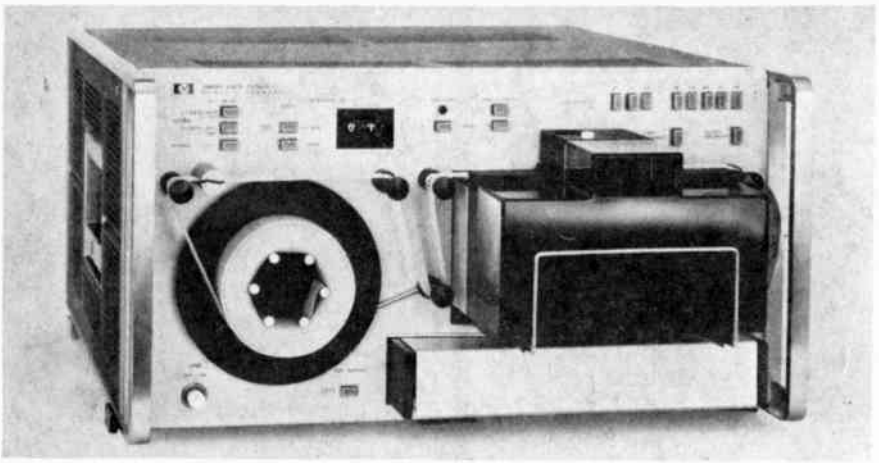
Noted for the "quietness" of their operation, very low distortion, and smooth level variation, they provide listening entertainment at its best. Why not contact our Engineering Products Division for information on the range of "quiet sound" audio equipment.

AWA ...*leaders in audio*

EQUIPMENT NEWS

DATA TAPE PUNCH FOR ON-THE-SPOT DATA COLLECTION



Designed for off-line date logging, a new, versatile data tape punch, Hewlett-Packard Model 3489A, with a wide range of formatting flexibility can be connected to measuring instruments that have TTL level, BCD coded outputs. Data entered on the punched tape is then fed directly into a computer or calculator for analysis.

Two new features built into the Model 3489A are line numbering and sampling control. A data counter built into the Model 3489A adds a 4-digit number to each data line when enabled by a front-panel switch.

Unattended operation is possible using the built-in interval timer. Sampling rate is controlled by the data punch rather than the measuring instrument. The data punch can be set to sample a measurement at intervals from 1 to 99 seconds or minutes.

The Model 3489A accepts up to 8 BCD digits of measurement data plus 1 BCD digit for range, 1 BCD digit for function, and 1 bit for polarity and overload. Punched data format and character codes can be programmed on a pin board. Some of the codes that can be programmed are:

8-bit EBCDIC for IBM 360/370 computers.

7-bit ASCII/ISO for minicomputer, calculator and data transmission.

6-bit Standard BCD for IBM 1401/10 computers.

5-bit CCITT No. 2 for telex and computers.

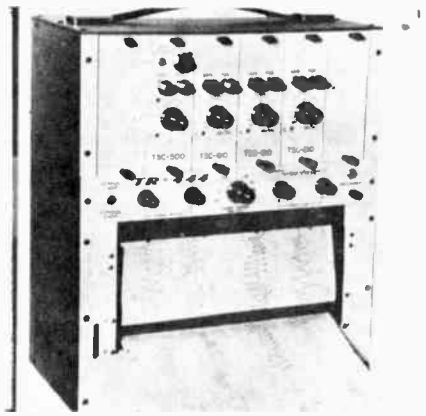
Data tapes punched by the Model 3489A can be fed directly into the appropriate computer, calculator or telex system.

Punching speed of the Model 3489A is 70 characters per second. Any code up to 8 bits can be programmed, along with special format characters. Tape is on a 1000 foot (300 metre) standard reel.

Up to 8-bit parallel characters from an external source, such as a computer, can be punched directly using an optional Bypass Card. A Time Input Card, another option, accepts up to 6 BCD digits of time information to be punched on the tape.

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

NEW FOUR-CHANNEL ANALOG RECORDER



Just released by Techni-Rite is a portable four-channel analog recorder for applications such as patient monitoring, seismology, mineralogy, welding analysis, and electronic gauging.

The TR-444 records inklessly from dc to 100 Hz with true rectilinear presentation.

There are eight electrically selectable paper speeds and right (or optional left hand) markers in this portable unit. The use of integrated circuitry has brought the weight down to 49 lbs.

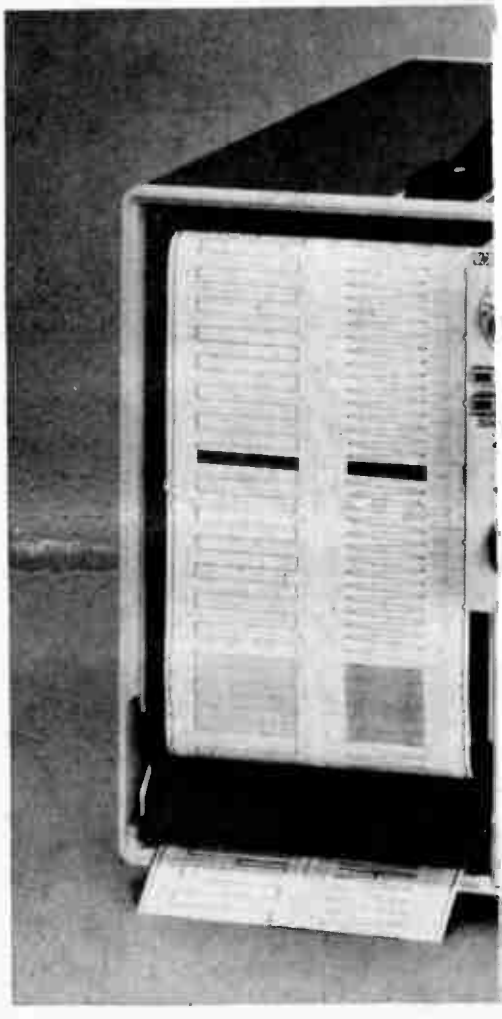
The chart paper, which comes on 280 ft. rolls, has four 50mm wide channels, each ruled with 50 lines.

The TR-444 offers a choice of plug-in signal conditioners which include medium gain plug-in with 10mV/div sensitivity (±0.25 volts full scale); medium-high gain – 1 mV/div (50mV full scale), with differential input and 10 times full scale for zero suppression; a plug-in module for recording the output of a strain gauge or transducer; and a high gain system with 50/uV per division and 10 times full-scale-zero suppression.

Further information from: DC Electronics Pty. Ltd., 32 Smith Street, Collingwood, Vic. 3066.

EQUIPMENT NEWS

2-CHANNEL OSCILLOGRAPHIC RECORDER



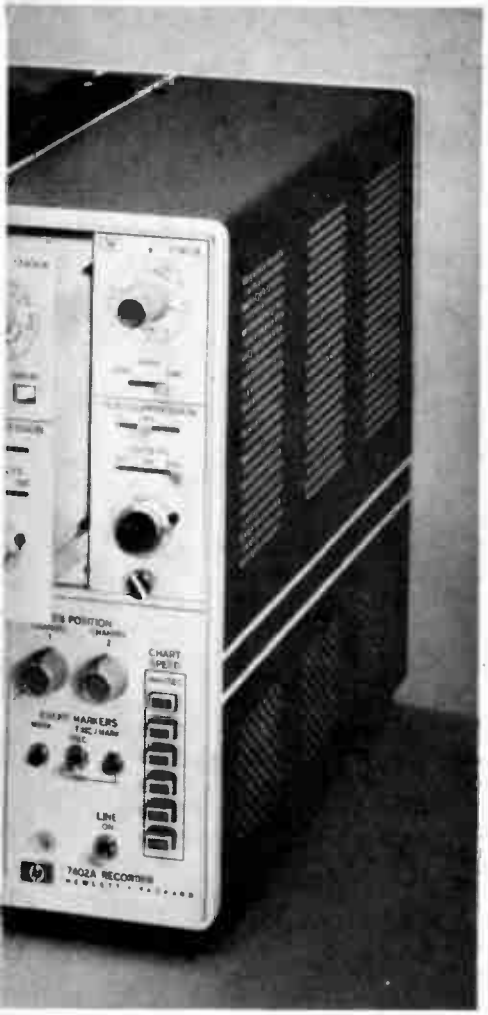
TWO-CHANNEL OSCILLOGRAPHIC RECORDER

A choice of input plug-ins, a new ink system, and carbide tipped, stainless-steel pens provide a reliable, yet low-cost two-channel oscillographic recorder. At least ten different combinations of signal conditioners can be used with this new Hewlett-Packard Model 7402A Oscillographic recorder.

Three preamplifier plug-ins are now available with sensitivities of one microvolt per division with a differential, floated and guarded input; one millivolt per division with a differential, balanced to ground input; and 20 millivolts per division with a single-ended input.

Stainless steel pens with carbide tips have been tested by Hewlett-Packard for two months in continuous use. Pen fatigue was unmeasurable and the manufacturers say that there was no apparent change in the trace after the pen had traveled about 2000 miles over 80,000 feet of chart paper.

Two versions of the MC14527 BCD rate



multiplier are available, the MC14527AL and the MC14527CL. The AL version can operate from a wide range of power supply voltages from 3.0 Vdc to 18 Vdc over the temperature range of -55°C to +125°C. The CL version works from a supply voltage of 3.0 Vdc to 16 Vdc for temperatures of -40°C to +85°C.

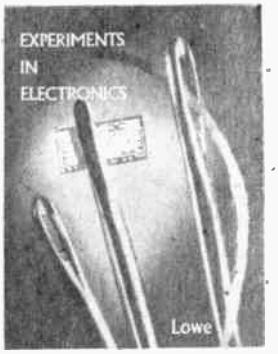
Chart width is 50mm, claimed to be 25% wider than available on other comparably priced recorders. Thus say Hewlett Packard, the Model 7042A has 25% better writing resolution, and with no sacrifice of frequency response.

Overshoot is less than 2%. Chart speeds are from 1 to 125 millimeters per second. Frequency response over 50 divisions (55 millimeters) is stated to be ± 2% of full scale from dc to 40 Hz. Rise time measured at the pen, from 10% to 90% of 50 millimeters, is 7.5 milliseconds for the model 17400A plug-in, and 7.0 milliseconds for the Models 17401A and 17402A.

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

BOOK REVIEWS

REVIEWER: Shaun Kannon



EXPERIMENTS IN ELECTRONICS by James F. Lowe. Published by McGraw-Hill 1972. 112 pages, 9¾ x 7½. Review copy supplied by McGraw Hill Australia Pty. Ltd. Price $7.50

This book is a practical laboratory manual, intended to complement the author's 'Electronics for Electrical Trades' or any equivalent study guide for the theory of basic electronics.

It fulfils adequately the objective stated in the foreword by the NSW State Supervisor of Electrical Engineering Courses, viz., to enable teachers to select laboratory experiments befitting the courses taught and levels catered for.

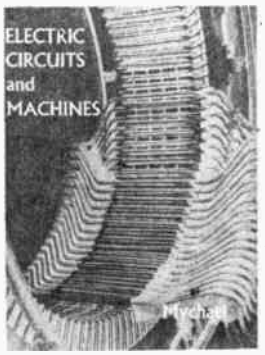
The exercises are graded in three levels: basic – involving measurements to confirm theory of operation of basic electronic devices; standard – demonstrating the application of basic devices; and advanced – examining advanced principles in the application of the devices.

A very useful section preceding each experiment is a discussion of the electronic principles involved and any special information relevant to the experiment.

The experiments are divided into groups, each related to the ten parts of the author's study book. Groups 1 to 3 deal with diodes, rectifier circuits and transistors. Group 4 deals with control devices such as thermistors and UJT's as well as circuits such as resistance-capacitance time-constants, relaxation oscillators and zener regulators. Groups 5 to 10 cover the thermionic triode, thyratron, thyristor, photo-resistor and photo-transistor.

The author seems to have confined the experiments to one or two specific devices or applications in each category. For example, one feels group 2 could have included resistor-capacitor filters and an experiment on ripple in the dc output as related to the filter RC time-constant. Group 7 could have included other forms of firing circuits for SCRs, etc. Perhaps this was intentional since the experiments were designed to use apparatus readily available in Australian Technical Colleges and to confirm parts of the study text in the basics of electronics. The reviewer's guess is that teachers may wish to amend or elaborate some of the experiments or open up further avenues, in which case the excellent manner in which the experiments have been set out should certainly help and guide them enormously.

Apart from one or two minor reservations (e.g. experiment 9 could have followed experiment 3 or preceded experiments 10-to-14 for a more logical progression of stabiliser circuitry), this book should prove extremely valuable for engineering and vocational teaching staff. – S.K.



ELECTRIC CIRCUITS AND MACHINES by Eugene C. Lister. (Australian Edition adapted by Arthur Mychael) Published by McGraw-Hill. Hard covers, 409 pages, 9¾ x 7½. Review copy supplied by McGraw Hill Australia Pty. Ltd. Price $3.25

The American editions of this book have been used in Australian Colleges for some time. This particular edition has been especially designed to cater for Australian Technical courses in electrical circuit and machine theory. To this extent, the re-writing has been confined to giving the text an Australian bias and changing references, where necessary, from the American 60Hz–110V to the Australian 50Hz–240V system. Advantage has also been taken, during this re-writing, to use metric notations and comply with SI standard units.

Subject coverage is extensive and thorough – as one has come to expect from American study books. Chapters one to seven deal with fundamentals of electricity and electro-magnetism, including sections on dc circuits, primary and secondary cells and electrical heating. The next two chapters cover dc machines. Chapters 10–to–13 deal with ac theory and circuits as well as transformers. AC machines are covered in chapters 14–to–17. The remaining chapters deal adequately with protective and switching equipments, instrumentation and measurements and some electron devices.

The treatment and presentation of study material is painstakingly thorough and progressive. The reviewer specially appreciated such nice touches as equivalent circuits for dc machines, but missed some of the finer embellishments one has seen in other American-originated publications – such as similar equivalent circuits for transformers or the development of machine equivalent circuits to derive and explain the properties of machines.

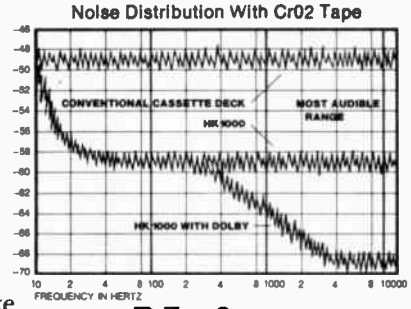
All the relevant chapters have a full complement of review questions and problems. The answers for the latter are also given at the end of the book. An adequate appendix section and an index complete the book.

As a course text-book or recommended reading matter on electrical circuits and machine theory for students at both trade and technician levels, the book is highly recommended for its content, level of treatment and presentation. The reviewer would, however, like to suggest that, in a later edition, the author and the adaptor may care to consider relocating the chapter (19) on instruments and measurements a little earlier in the book to help students and teachers alike in the laboratory and practical work necessarily accompanying class-room studies.

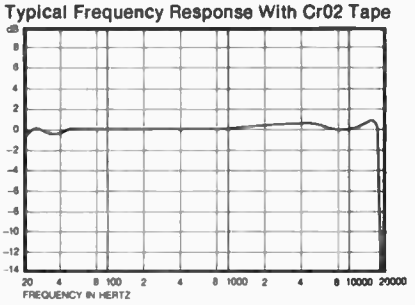
Arthur Mychael need have no anxiety about this text being non-terminating; the presentation and subject coverage are of a sufficiently high standard to ensure a solid foundation upon which further studies can be based. – S.K.

Never before has this little noise accompanied this much music.

Noise Distribution With Cr02 Tape



Typical Frequency Response With Cr02 Tape



If you're sophisticated enough to be reading this magazine, you're probably familiar with the two main characteristics of cassette decks: hiss and nonlinear frequency response.

Which should make you thoroughly unfamiliar with the performance capabilities of our new HK-1000. As the charts indicate, it behaves more like reel-to-reel than a cassette deck:

Noise.

Signal-to-noise (unweighted) is −58 dB with Dolby and −70 dB in the audible hiss level above 4,000 Hz. The frequency response curve is essentially flat from less than 30 to beyond 15 kHz, ±1.5 dB, with CrO_2 tape. (This curve is due largely to the way we drive our heads. Instead of the conventional constant *voltage* drive to the head, the HK-1000 is designed for constant *current* drive. Many studio model reel-to-reel decks are designed the same way.)

Because of a new low in noise and a new wide in frequency, the HK-1000 brings you a new clarity in music.

Music.

Ours is the first cassette deck designed for maximum phase linearity. Square wave response is better than every other cassette deck and even some expensive reel-to-reel decks. And the better the square waves, the cleaner and more transparent the music.

Discriminating audiophiles will also appreciate the wide selection of controls to take control of. There are two "peak-reading" VU meters; automatic shut-off in all transport modes; separate controls for recording playback and microphone levels; a "memory" rewind feature that lets you key a selection to the exact start location; a Dolby test oscillator; both record and Dolby playback calibration adjustments on the top panel; and so on.

The HK-1000 is also designed so you can use it often without endangering it. Plug-in printed circuit boards are used for simplicity and reliability of operation. Heads are easy to reach and clean. And the transport is the most reliable we've ever tested; it even closes with the sort of reassuring "thunk" you normally hear only by closing the doors of expensive hand-built cars.

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RECORDINGS... CLASSICAL

REVIEWERS: John Araneta, Christopher Wagstaff, Tanya Buchdahl

THE WORLD OF KING'S – Choir of King's College Choir (Cambridge), David Wilcocks (dir.) ARGO SPA 245.

An intelligent record, this, not only promotional-wise (does King's need it?), but for all those who like myself have worn down a couple of copies of "Evensong for Ash Wednesday" here is a more economical way of getting another copy of the performance of Allegri's Miserere, surely one of the great recordings of the century. For those who would have preferred to do without the service that accompanied that "Evensong" record the opportunity here should be obvious. The reproduction on this disc is in any case better than on the EP of the Miserere released some years back. In addition you get Handel's "Zadok the Priest", a truly imperial performance that surpasses any other in the catalogues. Byrd's "Ave Verum Corpus", Gibbon's "This is the Record of John", the Bach part-song "O Jesu so meek, so mild", a section from the Vivaldi Gloria, Tallis' "Sancte Deus", and finally, Scholefield's "The Day Thou gavest". I wish space had permitted the inclusion of yet another complete short work instead of the Gloria extract. But never mind. For the sake of completeness I must add that the Miserere has been slightly abridged, but one really loses a fraction of the text that is all, in music like this. If after all you have already got everything on this record, it will make a nice gift for those you know should have some of these. – J.A.A.

MOZART: Requiem K.626. Sheila Armstrong, Janet Baker, Nicolai Gedda, Dietrich Fischer-Dieskau; John Alldis Choir, English Chamber Orchestra/Daniel Barenboim. HMV ASD 2788 ($6.20).

In this recording Barenboim shows himself to be as good a Mozart conductor as he is a Beethoven pianist. A true child of the times, he is concerned with the most subtle of shadings, which most happily coincides with one of the most important features of Mozart's music. And also very importantly, he has not made the music for the dead deadly – that is, the music does not have to slow, dark or sombre because it is connected with death, because it is music commending the dead to God; and so it may be beseeching, resigned, contemplative – not symbolic sorrow. So the opening Kyrie/Christie, which is performed in an uncommonly 'musical' way with some of the entries eased in instead of the normal fashion of producing fugues loudly and as mechanically as if on a pianola – is followed by a fanatical performance of the Dies Irae (Day of Wrath) sung and played magnificently.

But rather than do an item-by-item analysis. I think it is pointless to discuss the choruses any further because the performance are consistently first-rate; the diction and control shown by this choir is a model for anyone to follow.

Of the soloists, I am not quite so certain. Sheila Armstrong sings most beautifully throughout, but I find Janet Baker's few entries curiously unemotional and lacking the the powerful personality which we usually hear from her. However, the entries are few and far between and it is probably pedantic to mention it. The men are consistently in tune with Mozart's thought in a wistful, almost resigned way (but speaking of being in tune, the third note of Fischer-Dieskau's Tuba Mirum solo is painfully sharp – most surprising from him) but it just may be because they have been recorded rather far from the microphones, as well as their own obvious abilities.

It is rather difficult to say much more about a performance as good as this because of its consistent quality. If, however, you prefer your Requiems to be of the very slow, devotional variety then I suggest the Boehm issue of DGG in which the performers are excellent but which I find impossibly slow; otherwise this HMV should be your choice. The merits of such a good performance show up the tragedy of Mozart's own death before the completion of the work – even with such a performance there is an uneasy feeling which sets in particularly after the Lacrimosa that Suessmayr's completion is just not Mozart, brilliant though it may be. Like the tragedy of the unfinished double fugue on B-A-C-H in Bach's Art of Fugue, one wonders what the finished product would have been like; and, completions notwithstanding, performances such as this serve to demonstrate both civilization's (?) gain and its loss at once. – T.B.

MAX REGER – Organ Music: Fantasie on the Chorale "Ein Feste Burg"; Introduction & Passacaglia in D Minor; Prelude in D minor; Benedictus in D-flat Major. Nicholas Kynaston (organ). CATHEDRAL Organ Masterworks. CRMS 851.

A "Wow!" to this "Ein feste Burg." Not the music mind you (it must surely rate as one of Reger's least imaginative, though there is a rather interesting polytonal section) but Kynaston's superlative and often stunning playing. He must be one of the few organists today unafraid to freely "dish out" rubato in this style of music. With taste too! Kynaston just flies effortlessly over the enormous technical difficulties (one look at the music of "Ein feste Burg" is enough to get you giddy) and superimposes a rock-life confidence and a real warmth of style.

Musically, the best work here is probably the rather simpler and more familiar "Introduction and Passacaglia" – quite a fine work. The sense of progression and continuity is further evidence of Kynaston's fine control – the theme flows on effortlessly from the pp pedal solo to the overwhelming and culmulative fff climax over a dominant pedal (the 32' reeds are added here with splendid effect).

The organ here used is that of Westminster Cathedral (Kynaston's own instrument for a number of years) – fairly well suited to Reger, though perhaps a little too heavy and in desperate need of more mixtures. As expected, Kynaston shows fine control of the 100-odd stop monster: the climactic ending (or should one say endings?) of "Ein feste Burg" is really quite stupendous and the interplays of the theme on the tuba are no doubt intended to have you whistling it continuously for two months.

A disc designed for any organist contemplating Reger's works to pack up and give up. – C.M.W.

MAHLER – Symphony No. 8. Harper, Popp, Minton, Watts, Auger, Kollo, Shirley-Quirk, Talvela, Vienna St. Op. Chorus, Vienna Singverein, Vienna Boys Choir, Chicago Symphony Orchestra, Solti (cond.). DECCA SET 534/5.

A curious symphony this. For the last time (?), a prophet-artist from the 19th century explicitates two of the most beloved aspirations of Romanticism in one work, the Middle Ages and the neo-(pseudo-) platonic pathos of Faust II.

Someone once said that if Mahler had stopped with this work, his achievement would reveal a strangely organic whole about it. I hardly think the organic unity of Mahler's achievement is lessened by his going on to Das Lied and Symphonies 9 and 10. Seeking a life-art solution to the problems posed by Symphonies 5-7 and the psychological crisis which beset the composer during this period, Mahler rather tragically opts at this point for what seems to me like the orthodox solution – Wagner, Liszt (as far as thematic language goes), religion (God, neo-platonism), Das Ewig-Weibliche, etc.

Enough has been said about the contrapuntal virtuosity of the First Movement, and in fact the First Movement is to my mind more listenable than that very Lisztian Second Movement. As usual with Mahler, orchestration is masterful but by comparison with the symphonies preceding the Eighth and Das Lied, there seems far too many effects more contrived than usual. That harmonium is, for instance, tasteless, not even ironic as is the case in the best Mahler. If all this seems a curious preamble to a review, you said it, it is. I do not much like Solti's Mahler. There are times when the vulgarity in Mahler's music is pointed out excessively – far too little repose as a contrast to the restlessness. But I have always thought Symphonies Nos. 6-8 might suit him far better, for different reasons.

Turn to page 115

Here are some way-up-front amplifiers... from PIONEER, naturally.

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SA-800. All the features of SA-600 with continuous power output 34W: IHF power bandwidth 5-50,000Hz. Extras include dual tape output terminals, dual phono input terminals; audio muting switch. New circuitry in the direct coupled power amp for vastly improved performance: Protector circuit prevents speaker damage.

SA-1000. Continuous power output 57W. IHF power bandwidth 5-50,000Hz. The SA-1000 has every feature of SA-800; additionally handles two mikes. Two pairs of tape deck jacks make two-way tape-to-tape duplication possible. Active high and low filters suppress all rumble, noise, hiss. Extra-sensitive click-stop type tone controls.

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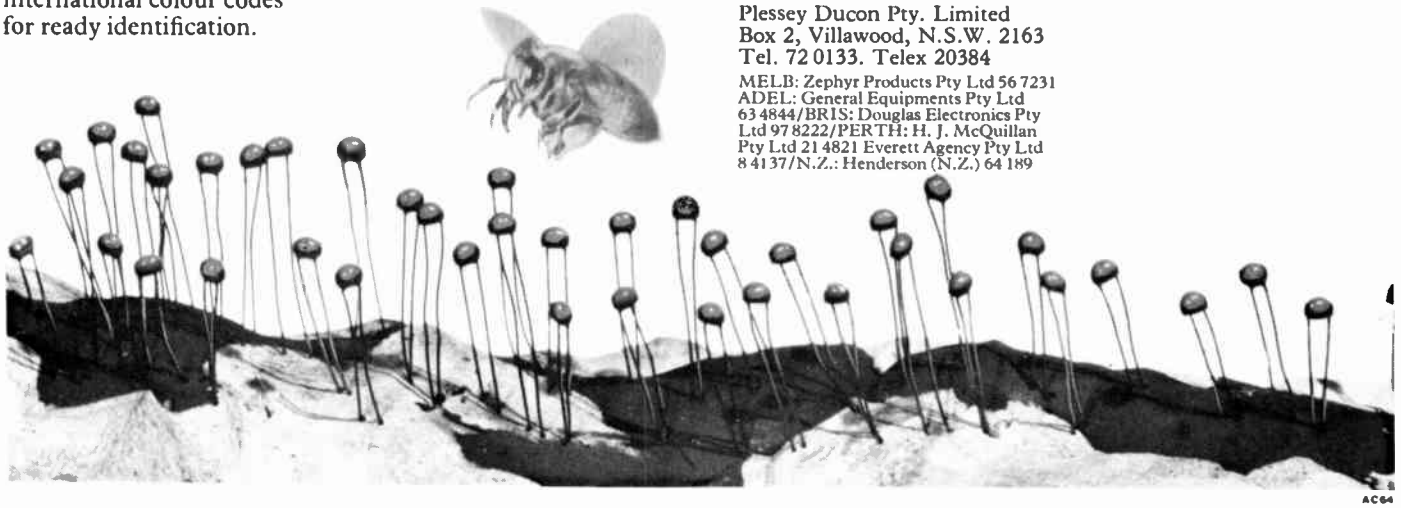

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CLASSICAL

(Continued from page 112)

Symphonies 6 and 7 are definitely restless, while the Eighth is just suitable for a great conductor of the Ring. After hearing this recording of the Eighth I wonder why Solti does not record some Liszt.

This recording of the Eighth is definitely the one to have. To begin with the sound is the best approximation I have heard of a live performance of this work. There are times when I wish the chorus was a little closer or that the soloists were not always so high-lighted, but this will do for some time. One better make sure the final grooves can be tracked properly. The Chicago Symphony plays incredibly at all times, the brass playing alone must be heard. Solti brings out the climatic passages magnificently; on the other hand I suppose some of the lyrical passages can be treated more leisurely. Certainly I feel that the end of the symphony could have been more successful if done a little deliberately or phrased to that effect.

Solti's team of soloists are the best to be had on records. There are lapses of pitches now and then from everyone, but this is not unusual after all. The Choruses are very finely differentiated and respond to the sometimes fierce attacks Solti requires of them. You might think other recordings have found more in this music. I am not sure there is all that much more to be found in this music, and in any case, if I were to have one recording of Mahler's Eighth I would have this one. – J.A.A.

LISZT – Symphonic Poems (Complete); Mephisto Waltz No. 1. Bernard Haitink, Concertgebouw Orchestra. 5-PHILIPS 6709005.

As I have reviewed the first three records in this series separately, I will limit myself to general remarks about the performances on those records.

As a rule, Haitink seems to be more successful with the less obviously stormy music (ie. Orpheus, Hamlet and Les Preludes). I do not think his performances of Tasso, Mazeppa and Hunnenschlacht are exciting enough or at least his methods do not seem much suited to these pieces. They are certainly played with taste and precision, but I feel taste is not enough and the phrasing of transitions and accellerandi are only too typical of what most modern conductors do in this music. On the other hand, Haitink's no nonsense approach works splendidly for Ce qu'on entend, no small matter, granted the rather wretched content of the work.

It was then with some misgiving when I came away with this set. After all the remaining tone poems are not exactly the best music there is. I therefore thought it prudent to begin with Heroide Funebre, knowing Haitink's prowess as a Mahler conductor. Haitink's performance here is in fact more ferocious than in any funeral march of Mahler's. I feel once again that the transition passages to and from the lyrical middle section are not managed so that the work seems a real whole. But this is a fine performance nevertheless. The Mephisto Waltz, which I played next, carefully leaving the more obvious poems for last, seems curiously disappointing. There is no fire to this Mephisto, no verve. I do wish Haitink had included Episode No. 1 from Lenau's Faust so we would have a more complete recording of the symphonic poems generally available. Coming at last to Nos. 5, 7, and 12, I must confess I am rather surprised how fine Haitink's performances are, rather exciting playing in all three. In particular, Die Ideale, strikes me as not such a bad work after all in this performance. Odd that Haitink should adopt a very fresh approach to these symphonic poems, but perhaps not so odd after all since they are almost never played these days. In sum, therefore, a very successful conclusion to the series.

If you do not want all these symphonic poems, PHILIPS will no doubt be issuing these records separately in the future, but it is good to have all this on records, especially since performances are rare, and because there is some very fine Liszt on these records, and it is the sort of Liszt most people still do not know. Recording is generally excellent, although there are moments in the first three records when the level seems to be rather low (in No. 13). Pressings are, sad to say, not always immaculate. My copy of Festklange had far too many clicks for comfort. Better try to hear a bit of each side before purchasing. In any case, my second copy is just about perfect. Very highly recommended. – J.A.A. ●

RECORDINGS... POP TRENDS

REVIEWER:
Michael Delaney.

"FOGHAT" – Foghat. W.E.A. Stereo. BR. 2077. I just Want To Make Love To You – Trouble, Trouble – Leavin' Again – A Hole To Hide In – Sarah Lee – Fool's Hall of Fame – Highway (Killing Me) – Maybelline – Gotta Get To Know You.

Foghat delivers the meat and potatoes. They don't hang about threatening to wield the phallus like Jo Jo Gunne – all plumage and no passion; and they don't mess around trying to be down home authentic like their parent band Savoy Brown. No. Foghat is a monster – a real pig not unlike the early Stones except that they rock a little deeper: not harder or dirtier – just deeper and more deliberate. Whereas the Stones can play things not always in context with the melody, juxtaposing ideas, contrasting textures and tones and then expanding on the result; Foghat sticks mainly to on beat, symmetrical stuff – playing it out in one lump sum. And that's the thing: the Stones are multi-directional in both presentation and performance; Foghat just keeps to the basic riff/rhythm – no liberties.

Most of what they do is drawn from the blues but, unlike a lot of other bands in this genre, they can rock with the authority of someone akin to earliest Creedence Clearwater circa "Good Golly Miss Molly". As a band, they don't need to pull any great punches purely because what they've got is natural: there's no way you can be taught how to feel – either you do or you don't. And Foghat feels: they seek out a direction and flog it rough as guts – similar to the J. Geils Band except that they don't let themselves get bogged down in the Chicago blues style, preferring straight rock 'n' roll.

Basically, Foghat makes it on energy. Their music is stark and aggressive – even bitter. It holds that same restless intensity reminiscent of the first Paul Butterfield Blues Band album: the images are sharp and incisive; the rhythms simply pungent and the involvement total. In many ways, Foghat is the group that Savoy Brown should have been had they not lost their enthusiasm. They're both doing the same type of thing, it's just that Foghat makes it viable and musically resilient whilst Savoy ends up lacking punch. And a rock band without punch is like no rock band at all.

Just how well Foghat gets down to its music can be seen in the way they've paid their dues: the whole message behind their approach is one of movement – pace rather than activity. There's the revamped "I Just Want To Make Love To You" and Chuck Berry's classic "Maybelline" – both of which exercise a degree of fluency rivalling the Stones in impact. Then there's a ballad by the name of "Gotta Get To Know" – a deceptively insinuating love song not far removed from the Stones' "Just Wanna See His Face". But it's more convincing. It reaches out in a strangely austere, provocative manner as direct as it is moving – an approach Foghat can use very well: something that is very much their own style.

Apart from this, they do the usual amount of hard boogeying – loud and clamorous and resonant with a lot of atmosphere. They rock dirty: not so much vindictive as mean – kind of like a less frantic Stones. "Feel's Hall of Fame" is one of their most satisfying cuts simply because it's intimate – the type of song you'd expect to hear in a road house. "Leavin' Again" is much the same – a randy 12-bar with the sex appeal of "Walkin' The Dog". They're both really fine.

The reason Foghat is such a together band is because they don't go to extremes: they're not out to prove anything to anybody. Sometimes, they ache and sound tortured; othertimes, they torment their feelings across from song to song and make the music scream. But the thing that packs the wallop isn't so much their emotional insistence as it is the unrelenting urgency with which each mood is portrayed.

A couple of the tracks, "Highway (Killing Me)" and "Sarah Lee" in particular, hurt real bad. It's a masculine, non-apologetic hurt that comes from their understanding: blues being the music of pain. And pain is universal – something that everybody experiences along with love. And that, in a nutshell, is why Foghat plays with such command: love is passion is pain. They're powerful and consistent; dynamic and sensitive – the stuff that great bands are made from.

Foghat is a great band – not brilliant or exceptional – simply great. Do yourself a favour.

"FULL CIRCLE" – The Doors. W.E.A. Stereo. EKS.75038. Get Up and Dance – 4 Billion Souls – Verdilac – Hardwood Floor – Good Rockin' – The Mosquito – The Piano Bird – It Slipped My Mind – The Peking King And the New York Queen.

This is the type of album that gets released by a hundred different bands each year: it's not bad and it's not particularly good – less than exceptional but not unimpressive. Everything's alright in its own way but it just doesn't go down. It just doesn't come together.

Since Jim Morrison's death, the Doors have been trying real hard to get themselves into shape: "Other Voices" didn't make it and neither does "Full Circle". But it does come a whole lot closer – certainly much more than the first. Still, they've missed out somewhere along the line: it hasn't quite fallen into place.

As a band, the Doors have got some nice things going: style, imagination, drive and a fair amount of confidence. They've got the gun as far as musicianship is concerned: the rhythms run clean with lots of variety and the overall presentation strikes just the right blend of power, wit and vitality to see them clear. But they can't write strong material. Their music doesn't lead its own life: the melodies are generally weak; the lyrics banal and the arrangements, although fiery and inventive, prove far too distracting.

Give the Doors a song, any song providing they didn't write it themselves, and they'll push it to the limit. They can bend it, turn it about, make it sinister or devious or raunchy or biting. They'll do most anything so long as you specify what you want. But you do have to specify – kind of like Morrison used to do: he'd handle the ideas and leave the group to manage the rest.

Basically, the Doors are still getting themselves out from being Morrison's back-up band. If "Full Circle" is any indication, they used to rely on Jim as their motivator, particularly in the more complex songs like "Spanish Caravan". It's a difficult move to make, changing direction mid-stream, but give them a bit more time and they'll swing it good. They've got one decisive things in their favour: they know how to play – a talent that requires taste and sensitivity. And that's something they share with only a few other American bands.

"Full Circle" divides itself into two sections: rock 'n' roll and a more emotive jazz-style rock. Both of them get by fairly

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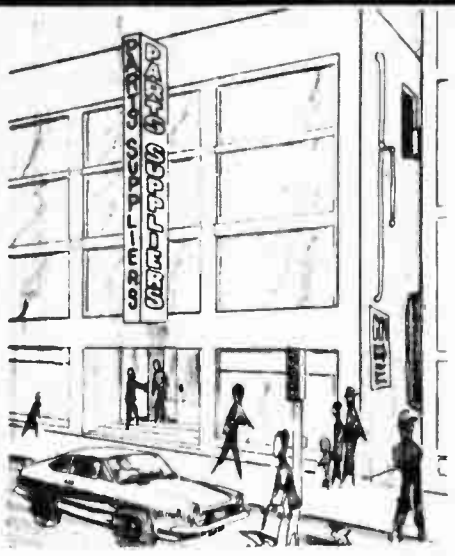

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well with top credit going to the no-nonsense stuff like "Get Up and Dance", "Good Rockin" and "Hardwood Floor" – the simple riff/rhythm songs. "Good Rockin' " comes off as the most effective possibly because it's the hardest, recalling the impact of their early works avec Morrison. It may be pure nostalgia, but it is interesting to note that it's the only track on the album not written by group members.

The heavier material suffers a bit in comparison because it's still hassling through the first stages, but, nevertheless, there's enough there to suggest that the band has finally found a field in which they can develop as their own main men. It's a relatively long term proposal – the kind of thing that isn't going to show up for a while yet. All it needs is perseverance: they should be pretty well there by the next album.

Most of the new stuff on "Full Circle" doesn't really stand out in view of this. However, a couple of the songs, "The Piano Bird" and "Verdilac", are reasonably positive steps in the right direction: the former takes on a nice Wes Montgomery feel; "Verdilac" is a quasi- Hendrix wah-wah piece similar to "Up From the Skies". The only other cut attempting anything novel is "The Mosquito" – a strange little song that starts off beautifully but then gets lost in a maze of bad tempo changes.

"Full Circle" you can either take or leave as an album. It's the type of thing that won't be remembered. The Doors have always been a good band, but now they need to be a whole lot better Jim Morrison still castes a long shadow. Production is average. ●

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The EIA rating is obtained by driving the main part of the amplifier by an external power supply of very high output capability. Thus the amplifier's power requirements are artificially maintained during peaks. The power output is then measured at 5% distortion level.

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Another rating has recently been suggested – by our Editorial Director. It is to be known as 'watts (USA)' and is calculated as follows.

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Where P = discounted price in dollars
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N = number of knobs
S = last digit of telephone number.

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I am a hi-fidelity enthusiast and I regularly pick up a copy of your magazine off the news stand. I would like to congratulate you on your excellent approach and production of your magazine. Yours is one of the few pieces of journalism which puts the interests of its readers before that of those who have a vested interest on the commercial and political line. Such consideration and consistency of policy is difficult to obtain especially in a magazine promoting the technical affluence of society. The success of ELECTRONICS TODAY INTERNATIONAL must surely be indicative of the appreciation of your awareness.

M.H.
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I would like to thank you for your very comprehensive letter to me concerning the LM370 AGC system sent on the 19th.

I wrote to many publications both in Australia and overseas concerning this problem, and either received no reply or to quote one magazine, "our staff cannot devote their years to single readers problems," I am glad your staff do not feel that way.

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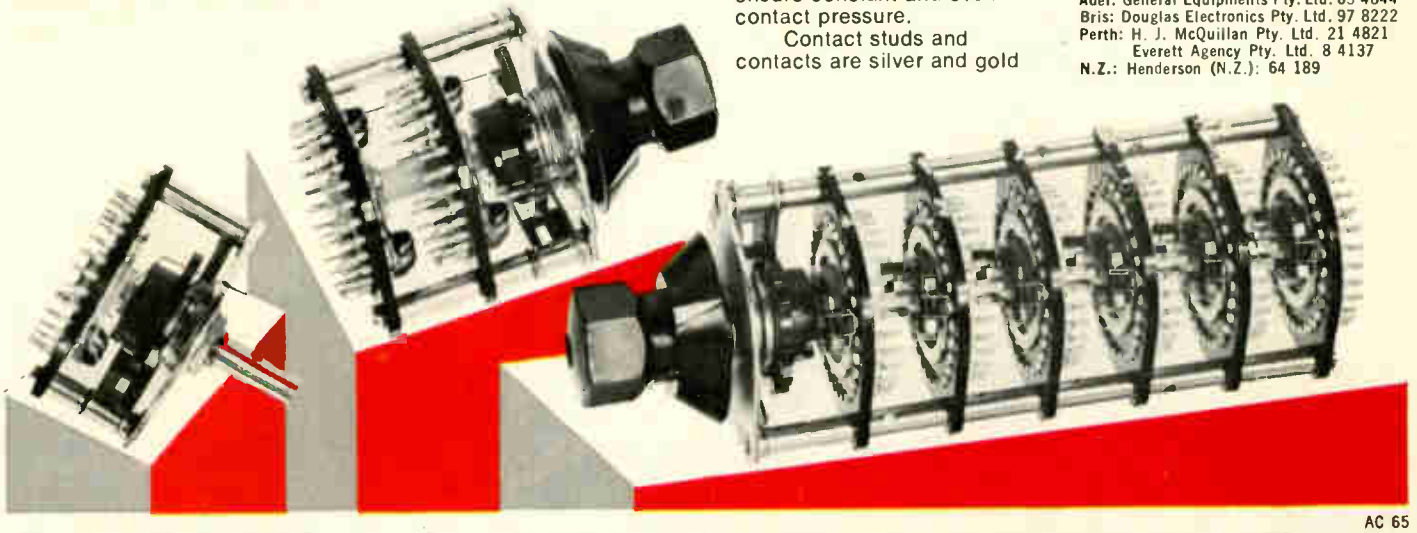

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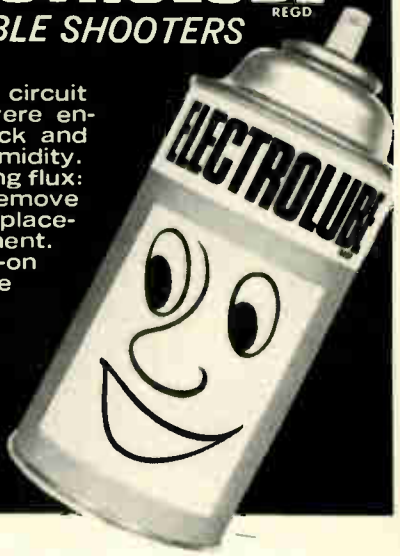

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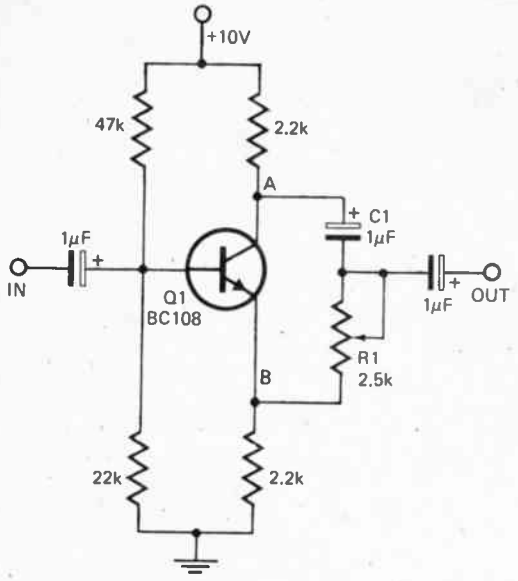

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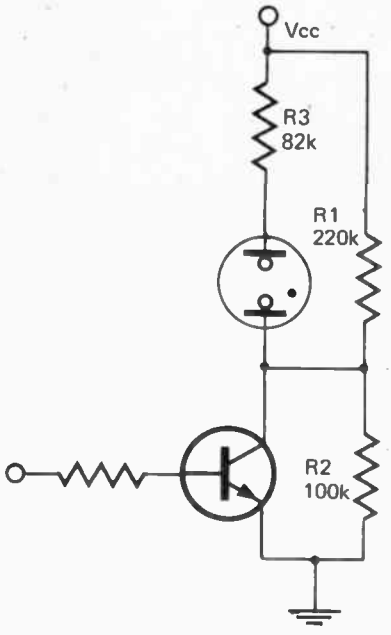

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news digest

ADVANCED SYSTEM FOR HIGH-SPEED TRANSPORT

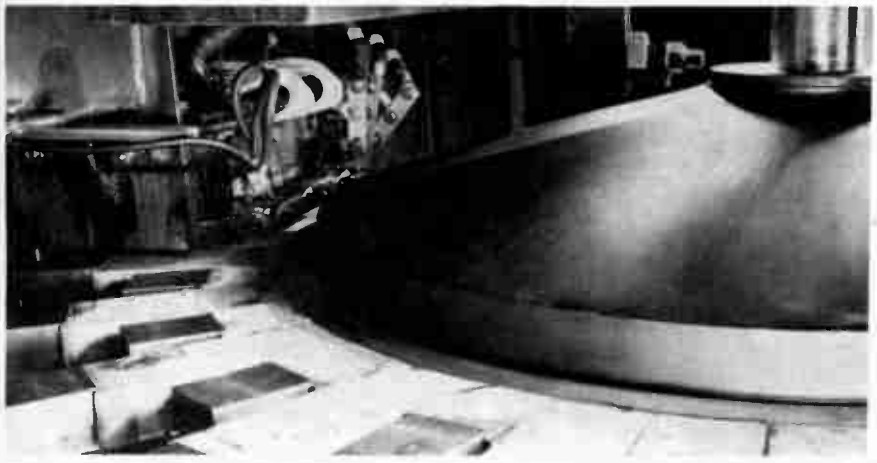
Experience gained in other fields of electrical technology is being applied by Siemens in Germany to the development of a high-duty railway using an electrodynamic suspension system with superconductive magnets.

The technique uses superconducting magnet coils in the vehicle and continuous conductor rails on the track. Motion of the vehicle generates currents in the conductor rails which lead to strong repulsive and self-stabilizing magnetic forces between the vehicle and the track. The high magnetic fields of superconductive magnets permit operation with a large air gap. Since the magnetic fields of superconducting magnet coils do not collapse suddenly, even in the case of disturbances – due to the stored magnetic energy and the physically inherent high time constant – the electrodynamic suspension system possesses outstanding emergency running properties. The suspension and guiding devices are also independent from stationary supply equipment while the vehicle is in motion.

On a test rig in the Siemens Research Centre the guide rail is initially being simulated by a rotating aluminium disc. Measurements are made of the lifting forces perpendicular to this disc, as well as their damping characteristics and the eddy current braking effects. The research workers state that it will not be long before they are in a position to present not only the experimental, but also the exact three-dimensional theoretical solution for the dimensioning of superconductive suspension and guide systems.

The railway will be driven by linear motors, of which both the synchronous and the induction types are being investigated.

The work will soon lead to trial operation on a test track in the grounds of the Siemens Research Centre, a circular track of 280 m diameter being scheduled. This track is to be used for long-duration tests at 200 km/h of the system and all its components, such as the linear motors and current collection gear.



news digest

AUTOMOTIVE ELECTRONICS

Unless American electronics manufacturers move quickly into the automotive electronics field, the Japanese will beat them to it as thoroughly as they have in many segments of the consumer market.

This warning was given by Lester Hogan, President of Fairchild Camera and Instrument Corporation at International Electron Devices meeting held in Washington last month.

Hogan went on to say that the Japanese are taking pollution more seriously than any other nation on earth and have recently adopted very tough environmental legislation.

(See also feature article 'Cars – Future Shock), page 16 onward in this issue).

AWA VIDEO DATA TERMINALS FOR A.P.O.

Ninety video-data units designed and made by Amalgamated Wireless (Australasia) Limited have been ordered by the Australian Post Office for use on the Common User Data Network (CUDN).

These terminals use the same advanced design with mini-computer control as the recently announced NCR 799 terminal. However, the editing and line control procedures are totally different and have required the development of a new program within the terminal to meet CUDN requirements.

This new program, which is contained on a single printed circuit board, has already been completed and demonstrations of a terminal operating under CUDN line control and editing procedures have been carried out.

Except for minor changes in the keyboard layout, no other re-design has been necessary to produce this entirely different terminal. It indicates the ease with which a programmable architecture can be adapted to interface with a wide range of systems.

The terminal also incorporates a unique "phantom multiplexer" design which permits a chain of interconnected terminals to operate as though connected through a controller to a single modem.

Bi-directional record and playback tape deck
Model A-4070
● 4 Ferrite heads (6 head function) ● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● Triple motor mechanism ● Wow and flutter .06% at 7½ ips ● F/R 25 to 24,000 Hz at 7½ ips ● S/N ratio 58dB

Make music- not noise

You may not realise it, but until now, even the best tape decks allowed a degree of noise during recording and playback. This may have been all right for conventional tapes, since they were far from perfect.

But with the recent introduction of the low noise/high output tapes, it's no longer permissible.

Which brings us to a new generation of decks by TEAC. And TEAC calls them Superior Sound/Low Noise decks: decks designed to get the most out of the low noise tapes as well as the conventional types.

Five of these new generation decks are described here. If you'd like to know more, write to us and we'll send you further information (catalogue, dealer list and price list) on the unit(s) that interests you.

Stereo Tape Deck
Model A-3300
● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● Triple motor mechanism ● Wow and flutter .06% at 7½ ips ● F/R 25 to 24,000 Hz ● S/N Ratio 55dB

Stereo Tape Deck
Model A-1230
● 3 heads-4-head function ● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● Triple motor mechanism ● Wow and flutter .08% at 7½ ips ● F/R 30 to 22.000 Hz at 7½ ips ● S/N Ratio 55dB

Automatic Reverse Stereo Tape Deck
Model A-1250
● 3 heads-4-head function ● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● Triple motor mechanism ● Wow and flutter .08% at 7½ ips ● F/R 30 to 22.000 Hz at 7½ ips ● S/N Ratio 55dB

Combination Head Stereo Tape Deck
Model A-1030
● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● One motor mechanism ● Wow and flutter .08% at 7½ ips ● F/R 30 to 22,000 Hz at 7½ ips ● S/N Ratio 55dB ● Auto. Shut-off

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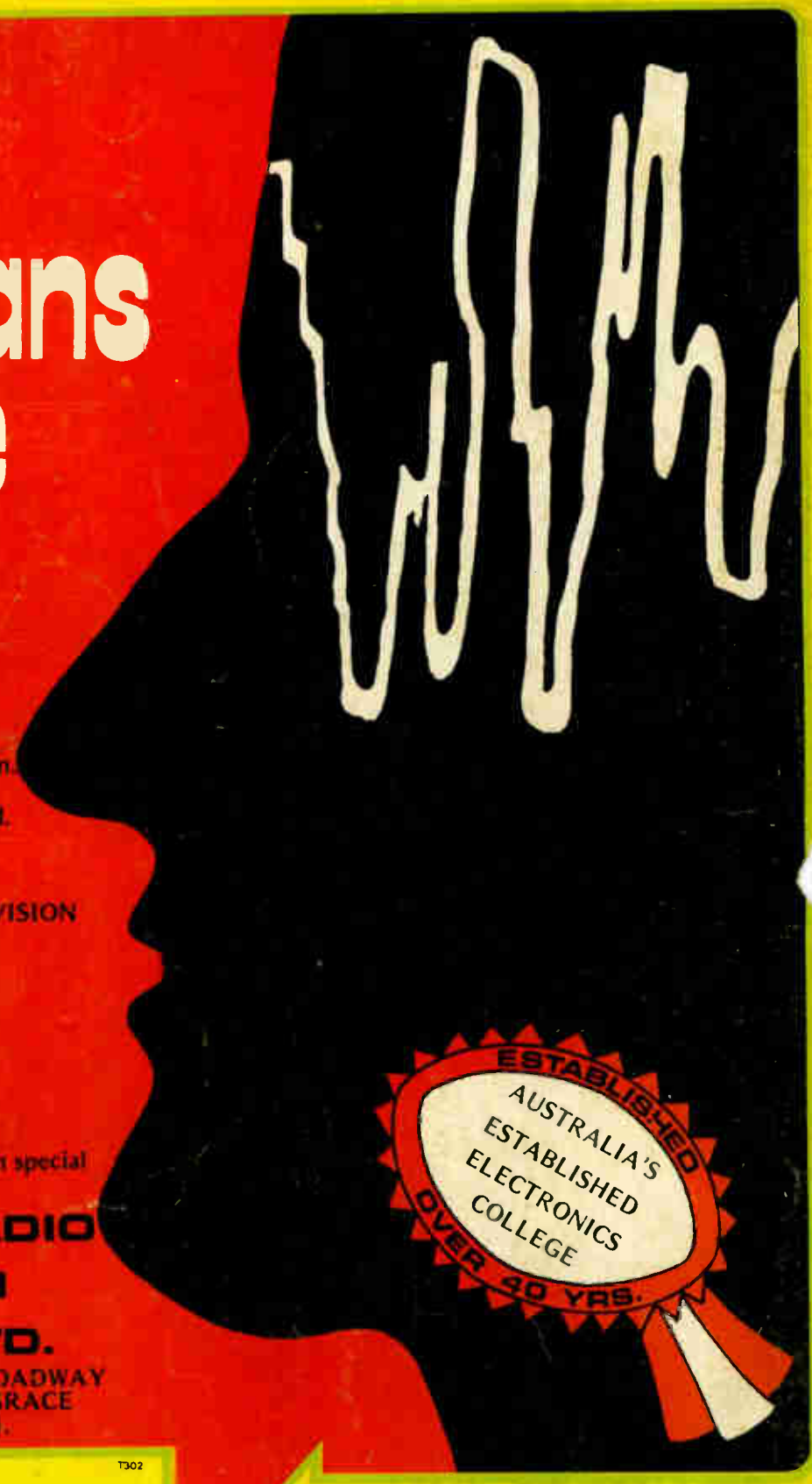

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