APRIL, 1974
60c*

electronics TODAY INTERNATIONAL

HI-FI

Registered for posting as a periodical—Category C

PROJECT – UNDER $60 4-CHANNEL SOUND!

REPAIRING DIGITAL EQUIPMENT – SPECIAL 10-PAGE FEATURE

You wouldn't buy the wrong pair of shoes for your feet.

So why buy the wrong tape deck for your home?

It can happen. There are so many to choose from. Each has its own way of enticing you.

Yet the TEAC A-3300 stereo tape deck stands out. It has everything a serious amateur would want, plus many features that even the professionals love.

It accepts the big 10½ inch reels. So when you give your next party, you'll have uninterrupted music for up to six hours. Instead of having to change tapes all the time.

Your own recording technique will improve also. Because the A-3300 has TEAC's unique Edi-Q, an electronic record pause control. It eliminates the clicks and snaps that can occur when you pause and then restart. The professionals use it. Now you can also.

You'll especially appreciate the front panel bias switch for the proper selection of bias current and recording equalization. It's an important feature; it gives you the most enjoyment from the new low noise/high output tapes, as well as regular tapes.

Attach TEAC's A-180 to the deck.

It's our Dolby* Noise Reduction Unit. You'll enjoy sound perfection because the Dolby eliminates unwanted tape hiss and other noise. Music never sounded so good. We invite you to take the step and bring this TEAC package of sound into your home.

Notice how well it fits.

AN-180

TEAC
The sound of perfection

AUSTRALIAN DISTRIBUTORS: Australian Musical Industries P/L., 155 Gladstone St., South Melbourne. Vic. 3205 Phone: 69-5888 — 619 Pacific H'way., St. Leonards, N.S.W. 2065. Phone: 439-6966 — Arena Distributors, 273 Hay St., East Perth. Phone: 25-9993 — Sth. Aust. Truscott Electronics Pty. Ltd., Hindmarsh Square, Adelaide. Phone: 23-3024. Miltons Department Stores Ltd., P.O. Box 146, Norfolk Island. OCEANIC DISTRIBUTORS: New Zealand: Direct Imports (N.Z.) Ltd., 590W Southampton Street, Hastings. Phone: 89-184 — Fiji: D. Jeevan & Sons, 87 Cumming Street, (G.P.O. Box 148), Suva. Phone: 22710 — New Guinea Paul Mow & Co. Box 449, Lae. Phone: 2953.

electronics TODAY INTERNATIONAL

APRIL 1974 Vol. 4, No. 1

main features

product tests

projects

reviews

news & information

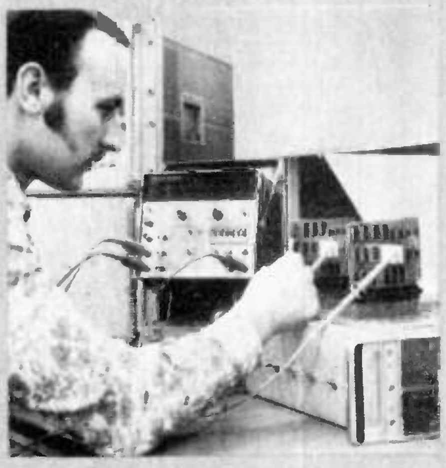
COVER: Electronic Today's under $60 four-channel project is seen here on an EPI Micro-tower loudspeaker. (full details of four-channel project page 74, onwards, this issue).

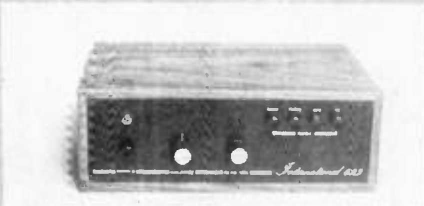
Due to a protracted inter-union dispute, nearly all mail from our (Potts Point) post office has been held up for nearly two weeks.

Because of this, several articles scheduled for this issue have been unavoidably ommitted.

These are, Electronics – it's easy!; the Pirate Radio follow-up and the Classical music reviews.

We apologise to readers for these ommissions which have been caused by circumstances totally beyond our control.





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FM RADIO a side-effect?

THE recent independent inquiry into FM radio has recommended that the proposed new broadcasting network use the VHF band — rather than the UHF band as first suggested.

A further recommendation is that stereo FM broadcasting be introduced using the so-called 'pilot-tone' technique.

We believe that this is a correct decision and one that we hope the Australian government will implement as quickly as possible.

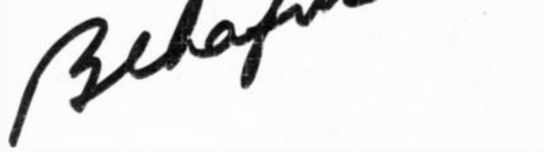
One side-effect of FM radio may well be a fall in the sales of gramophone records and record playing equipment.

During the past twelve months there has been a quite dramatic improvement in the performance of cassette recorders and cassette tapes. Even quite low-priced machines now have performance all but indistinguishable from gramophone recordings.

It is certain that purchasers of these machines will use them to record directly from FM broadcasts, especially stereo broadcasts, rather than spending $7 or so on a gramophone record of a similar performance.

Whether such recording is legal is far from clear. Despite many statements to the contrary, there does not seem to be any clear breach of copyright in making such recordings for one's *own private use*. Even if private recording *were* to be found illegal the law would be virtually impossible to enforce.

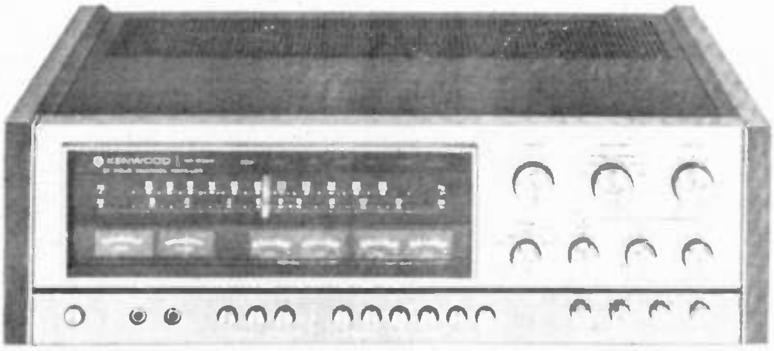
The way gramophone record quality is going right now there must be many who can hardly wait!



SELSOUND presents

the futuristic 4 channel sound of

KENWOOD



KR-9340

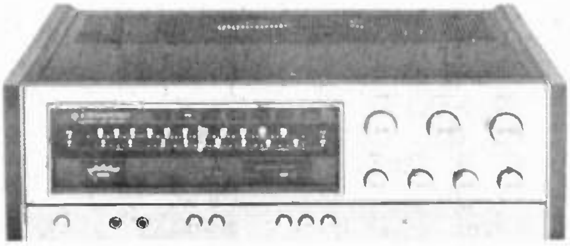
An assembly of superlatives — the top model in the new Kenwood line of Two-Four Receivers, and certainly one of the world's truly great audio products.

* Built in SQ and RM 4-channel matrix decoders.
* Accepts plug-in CD-4 demodulator, model KCD-2.
* 4 x 40W output power (RMS) in 4-channel operation.
* 4 level meters for accurate channel balancing.
* AM/FM stereo tuner with exclusive DSD system.
* Signal strength and centre-zero tuning meters.
* Accepts two turntables, two 4-channel tape decks.
* Tape-to-tape duplicating possible.
* Drives up to eight speakers: 4-channel sound in two rooms.

KR-8340

Second from the top among Kenwood Two-Four Receivers is a position that means "among the very top worldwide".

* Built-in SQ and RM 4-channel matrix decoders.
* Accepts plug-in CD-4 demodulator, model KDC-2.
* 4-channel output is unconditionally guaranteed to be 25W x 4 (RMS 8 ohms) at 20-20,000 Hz.
* Both front and rear have separate bass and treble tone controls for complete 4-channel tone control.
* Two sets of 4-channel speakers can be connected. Either speaker system can be selected or both can be used at the same time.
* High and low filters are included: Unpleasant scratch and rumble from turntables is eliminated for pleasant listening.



KE-6340

* 15W x 4 (RMS 8 ohms) output at 20-20,000 Hz unconditionally guaranteed.
* In 2-channel operation (stereo receiver) 40W x 2 (RMS 8 ohms) at 20-20,000 Hz is guaranteed.
* With the CD-4 unit (KCD-2) which is plugged matrix circuits, all 4-channel program sources are available.
* Coaxial-shaft V.R. is used to simplify the usually complicated 4-channel volume and balance control. Just two switches give complete control.
* Both front and rear tone controls are separate to make possible natural 4-channel sound.
* Two sets of 4-channel speakers can be connected.

For the full story "AND THE BEST PRICES" on Kenwood latest 4 channel equipment contact

SELSOUND HI-FI

619-621 Princes Highway, Blakehurst. Phone 546 7462

amcron

Crown International U.S.A.

BY CROWN INTERNATIONAL

If diamonds are the epitomy of value and quality in the realm of gems, then the Amcron IC150 control unit and D150 power amplifier is its equal in the sphere of electronics.

The superb craftsmanship required in cutting and polishing a diamond, is equal to the highest degree of craftsmanship employed at Amcron, where quality is a creed, not just a mere claim.

Unlike the price of diamonds, Amcron equipment is not sold by the carat (or watt), and the IC150/D150 amplifier combination is a reasonably priced superlative product.

You are assured of Amcron's unwavering and uncompromising dedication to excellence, when you consider the IC150/D150 combination, as the amplifier to grace your home. Your ears deserve Amcron.

$845

SPECIFICATIONS:

IC150

Frequency Response:— HI-LEVEL ±0.6 db 3 Hz-100 kHz; PHONO ±0.5 db of RIAA, calibrated. **Hum and Noise:**— HI-LEVEL 100 db below 2.5V, "A" weighted; PHONO 80 db below 10 MV input. **Distortion:**— THD essentially unmeasurable; IM .003% at rated output. **Phono Input:**— Sensitivity 1MV at 1kHz for 2.5V out; Overload 33-330 MV at 1kHz (adjustable). **Output:**— Rated at 2.5 volt, typically 10V before overload. **Volume Control:**— Over 60 db dynamic range with calibrated tracking. **Loudness:**— Excellent simulation of Fletcher Munson curves down to 60 phono, co-ordinated with volume control. **Phase Shift:**— Typically + 1° to −12° 20Hz to 20 kHz. **Tone Controls:**— ± 15 db at 30 Hz to 15 kHz. **Filters:**— (High and low filters).

D150

Frequency Response:— ± 0, 1 db 20-20 kHz at 1 watt into 8 ohm; ± 1 db 4-100 kHz. **Power Output:**— 100 watt RMS into 8 ohm, both channels operating. **Power Bandwidth:**— ± 1 db, 5-20 kHz at 75 watt RMS into 8 ohms. **Distortion:**— THD typically 0.002%. (At .01 to 75 watts) IM typically 0.005%. **Damping Factor:**— Greater than 200 from zero to 1 kHz 8 ohms. **Weight:**— 25 lbs.

THE AMCRON PHILOSOPHY

"While the plastic generations of audio equipment come and go, the steadfast performance, the unflinching quality, and the unparalleled construction of all Amcron equipment will remain."

Audio Magazine said:— "IC150 — We were all able to measure hum and noise levels of approximately — 93 db below 2.5 volts output, and phono noise of about .50 microvolts — D150 — at a typical output of 75 watts (8 ohms) IM was measured at 0.002%, by implication, THD might be expected to be approx. 0.0005% which neither Amcron nor we could measure. If you want the very best, our endorsement of the IC150/D150 is completely given without any reservations.

Stereo Review said:— IC150 "We found the frequency response to be down only 0.3 db at our lowest limit of 5 Hz and 1 db at 225 kHz. The RIAA equalization was so accurate (±0.25 db) that we may have been checking the residual errors in our setup."
D150 — "There are not many speaker systems capable of absorbing the full output of the D150, but since its distortion at any level, can only be measured with the most advanced test equipment, one would expect it to sound first rate, and indeed it did."

AVAILABLE FROM:

QLD:
Stereo Supplies — Brisbane 213-623.
Brisbane Agencies Audio Centre — Valley 219-139.

NSW:
Instrol — Sydney 29-4258.
Kent HiFi — Sydney 29-6973
Arrow Electronics — Sydney 29-8580.
Miranda HIFI — Miranda Fair 525-6745.
Audio Gallery — Warringah Mall 938-2205.
Audico Sound Systems — Nth. Lambton 570-501.
Audio World — Wollongong 295-110.

ACT:
Duratone — Phillip 821-333.

VIC:
Douglas Trading — Melbourne 639-321.
Instrol HIFI — Melbounre 675-831.

TAS:
Quantum Electronics — Hobart 281-337.
Audio Services — Burnie 312-390.

SA:
Sound Spectrum — Adelaide 223-2181.

WA:
Alberts TV and HIFI — Perth 215-004.
Perth HIFI — Perth.

AUSTRALIAN DISTRIBUTORS:

BJD Electronics Pty Ltd.
202 Pelham St., Carlton, 3053 Vic. Ph. 347-8255
190 Willoughby Road, Crows Nest, 2065 N.S.W. Ph. 439-4201

AUTEL SYSTEMS PTY LTD

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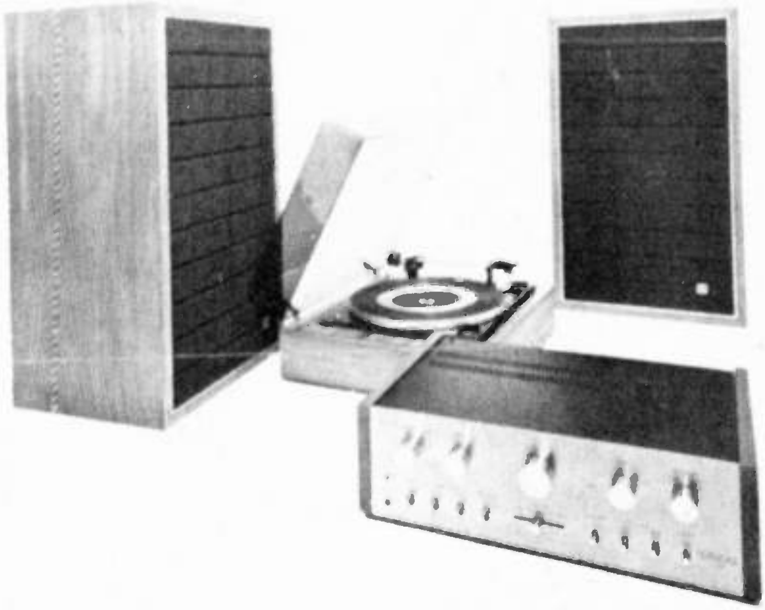
Compare all types of equipment to make your choice including a special deal on A.M.I.-Jorgen equipment for "Stereo Answers" readers.



Unit 333
Retail price $199
333 Amp, SE.25 speakers
Garrard 40B turntable
5 watts rms, 6" 2 way speakers

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Retail price $299
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Unit 666
Retail price $499
666 Amp, SE.200 speakers
Dual 1216 TT Shure 75ED cartridge

To "Stereo Answers" readers only, a special price on the above equipment is available while stocks last.

Call in and ask for a demonstration of above;
service agents for TEAC, Jorgen, National, Nivico, Phase Linear, ESS, Advent, KLH.

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RS AHEAD

The AMT-1 is available from the following leading capital city retailers. Distribution will be expanded as and when stock permits.

N.S.W.

AUTEL SYSTEMS PTY. LTD., 639 Pacific Highway, Chatswood, Sydney, 2067. Phone 412 4377

CONVOY TECHNOCENTRE, Cnr. Plunkett & MacLean Sts., Woolloomooloo, Sydney, 2011. Phone 357 2444

INSTROL HI-FI CENTRE, 91a York Street, Sydney, 2000. Phone: 29 4258

KENT HI-FI PTY. LTD., 432 Kent Street, Sydney, 2000. Phone: 29 2743, 29 6973

VIC.

DOUGLAS TRADING, 185-191 Bourke Street, Melbourne, 3000. Phone: 63 9321

INSTROL HI-FI (VIC.) PTY. LTD., 375 Lonsdale Street, Melbourne, 3000. Phone: 67 5831

SOUTHERN SOUND PTY. LTD., 963 Nepean Highway, Moorabbin, Melbourne, 3189. Phone 97 7245

and also at:
337 La Trobe Street, Melbourne, 3000. Phone: 67 7869

QLD.

STEREO SUPPLIES, 95 Turbot Street, Brisbane, 4000. Phone: 21 3623

S.A.

NO DEALER YET APPOINTED

W.A.

ALBERT'S HI-FI CENTRE PTY. LTD., 282 Hay Street, Perth, 6000. Phone: 21 9902, 21 5004

PERTH HI-FI CENTRE, 396 Murray Street, Perth, 6000. Phone: 22 4409

LESLIE LEONARD HI-FI, Shop U8, Upper Level, City Arcade, Hay Street, Perth, 6000. Phone 22 3243

TAS.

NO DEALER YET APPOINTED

ESS amt 1

Recommended retail price $628.00 per pair. See any of the dealers listed for a demonstration of the AMT-1 or for further information contact

ESS Inc., ET2, c/o 220 West St., Crows Nest, N.S.W. 2065. Ph. 43 3228

Heil Air Motion Transformer is the registered trademark for ESS loudspeaker systems incorporating design principles invented by Dr. Oskar Heil and licensed exclusively to ESS Inc.

Instrol System 239 ←

Featuring the Audioson "Camelot" speaker systems, the Rota amplifier (12 Watts RMS per channel), the high quality Garrard Player with magnetic cartridge, base and cover, and you have unbeatable value at the list price of $313.00; let alone at the special Instrol price of $239.00

Complete Hi-Fi Catalogue 50 cents

Please send me your complete full-colour hi-fi catalogue and price list containing full details of hi-fi systems and separate hi-fi components. I enclose herewith postage stamps or money order to the value of 50 cents. I understand that the 50 cents will be refunded on my first purchase.

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INSTROL HI-FI

SYDNEY
91a York St.,
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Phone: 29-4258

MELBOURNE:
375 Lonsdale St.,
(near Elizabeth St.,)
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INSTROL FOR QUALITY HO SOU

Featuring the Monarch 80 amplifier (15 watts RMS per channel), the now famous Audioson "Camelot" Speaker Systems, the Garrard SL-72B changer, base and cover, and the smooth response of the ADC magnetic cartridge. This is value plus at $339.00

Instrol System 339 ←

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PROJECT 250 HIGH QUALITY 25 WATT STEREO AMPLIFIER FROM

ONLY $14.95

* HUGE BREAKTHROUGH IN COST
* GUARANTEED NO PARTS MISSING
* AS USED BY LEADING MANUFACTURER
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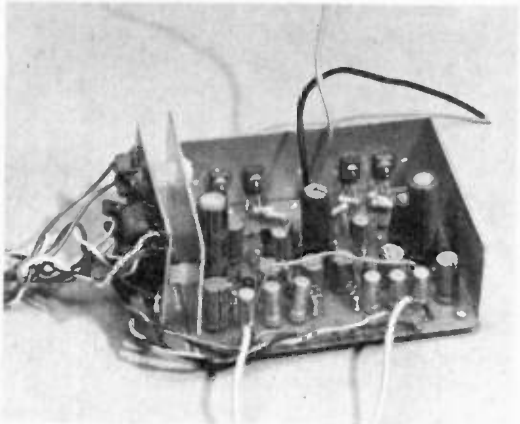
* FOUR 8 OHM SPEAKERS



* HEATSINK AND FULLY TINNED PCB INCLUDED
* 10 TRANSISTORS, 4 DIODES, LOW DISTORTION OTL DESIGN
* PREAMP/TONE CONTROL NETWORK BUILT-IN
* COMPONENTS ALONE WORTH MORE THAN COST OF THIS FULLY ASSEMBLED AMPLIFIER.
* FULL PROVISION FOR VOLUME, TREBLE, BASS AND BALANCE CONTROLS
* 25 WATT PEAK TOTAL POWER (12.5W TOTAL RMS)

Are you sick and tired of buying kits that aren't complete? Are you fed up with waiting for back orders? Well we know how frustrating it can be for you and until now there has been little we can do to help. It's been extremely difficult to locate parts while this shortage goes on. But once in a while we can do something to make you happy and our life a little bit easier. So here's the good news –

We have made special arrangements to import a large number of high quality pre-assembled amplifier modules. YES THEY ARE ABSOLUTELY COMPLETE. WE GUARANTEE NOT A SINGLE PART MISSING. All you have to do is wire in the four controls, connect a power supply and you have a fully working amplifier. The same job is in fact being used by a leading manufacturer in equipment that sells at $150.

There are no special parts, ICs etc in this amplifier. It is entirely conventional using OTL (output transformerless) design. Transistors are epoxy types from Motorola, Caps and resistors are Philips. 10 transistors and 4 diodes. Need we say more?

Ready to take ceramic pickup direct or magnetic via a pre-amp.

Give it a go. Whether you're an advanced constructor or a beginner you'll get this going in no time. We supply full instructions, circuit etc. You simply have to connect controls and power supply. We can supply the amp in various forms as described below.

Money back if not satisfied. Yes!! The usual Dick Smith guarantee applies to this kit. Inspect for 7 days and return if not satisfied, untouched, and we will refund your money less P&P. HAVE YOU EVER SEEN AN OFFER LIKE THAT ON A KIT?

Twice the power of it's nearest competitor. Prebuilt, Tested, Available Ex-Stock. No hard to get ICs . . . all this at 20% less than its nearest rival. It's ridiculous eh?

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Use this order form GUARANTEED IN STOCK FOR INSTANT DESPATCH

Tick boxes as required and send your remittance for immediate delivery.

☐ **PROJECT 250A KIT** includes fully built and tested amplifier, full circuit and suggested power supply circuit. Simply add your four pots – 3 x 50k dual log and 1 x 50k single linear – various wires and a power supply. Approx. 24-30V @ 1A. AMAZINGLY LOW PRICE ONLY $14.95 (P&P $1.00).

☐ **PROJECT 250B KIT** exactly as 250A above but also includes four rotary pots. All you need to add is a power supply and some wire links. $19.95 (P&P $1.50).

☐ **PROJECT 250C KIT** Includes amp and controls as 250B above. Plus a full power supply kit. It will take under an hour and some wire links to complete the amplifier. Here is a COMPLETE kit for a 25W amplifier for $29.95 (P&P $2.00).

Name . . . .

Address . . . .

. . . . Postcode . . . .

I enclose cheque/Money Order/Postal Order to value $ . . . .

NOTE: ALL KITS LISTED ARE IN STOCK IN LARGE QUANTITIES. NO WAITING, NO PARTS MISSING. DEMAND MUST BE HEAVY FOR THIS TERRIFIC OFFER. SEND NOW.

Other suggested accessories in stock at time of going to press but not guaranteed to be in stock, possible delays of upto 3 weeks depending on demand.

☐ **Metalwork kit** $8.00 (P&P $1.00) Intended for the popular Playmaster 136 but easily adapted. Finished in light grey hammertone.

☐ **Front panel** $3.00 (P&P 5ocents) from the Playmaster 136 satin finish looks quite posh. Easily adapted.

☐ **6" speakers** (as used in our demo) C6LX (or similar) $8.75 each (P&P $1.00).

☐ **Speaker Box kit** to suit Professionally precut in TEAK with Innerbond and grill cloth etc. $16.50 each (P&P Road freight).

☐ **BSR Turntable** G11.204 Fully automatic $39.00 (P&P $2.00)

DICK SMITH WHOLESALE PTY LTD 160-162 Pacific Highway, Gore Hill NSW 2065. Tel 439 5311

news digest

AUTOMATIC BAGGAGE CONTROL SYSTEM

SOUTHFIELD, MICH. — A fully-automatic baggage control system has been developed by the US Bendix Corporation's Recognition Systems division (Farmington, Michigan) in conjunction with Eastern Airlines.

Designed to both identify and sort baggage, the system promises to significantly improve service by reducing the number of mishandled bags, and to reduce costs associated with conventional handling practices.

The system uses coded labels, printed on demand at baggage check-in points, along with laser beam code readers and digital controllers to sort baggage for as many as 1024 different flights or destinations as it moves along a conventional conveyor system at speeds up to 100 metres per minute.

Key element of the system is the unique coded baggage label, printed to order on a Bendix Model 302 printer at each baggage check-in point. The label contains a (circular) 10-bit code that defines up to 1024 separate flight numbers or destination points.

The labels are printed on an adhesive-backed paper designed for easy application and removal without damage to baggage.

The coded labels are printed in response to an operator's entry of flight and destination information. When the operator depresses a "print" bar, the Model 302 produces the coded label within five seconds. Using the same data, it produces a conventional baggage handle strip label and passenger claim check within two seconds.

The coded label is pressed onto the side of the baggage where it will be read by subsequent scanning equipment in the baggage handling system. The circular code enables the label to be read in any rotational position, as long as the label is facing upward toward the overhead laser code reader.

The Bendix Model 103 code readers are mounted over the conveyors where they scan baggage passing through at a normal reading distance of 75 cm plus or minus 30 cm. This depth of field provides for a wide range of baggage thickness. In addition, the readers can cope with labels misaligned by as much as plus or minus 20 degrees from a plane parallel to the reader face.

Digital computers are used automatically to correlate identified baggage with a current master flight schedule to ensure that the baggage has been properly processed before dispatching. The system then activates a memory sorting unit which routes each bag to the correct conveyor spur line leading into the baggage loading area.

The system maintains a running total of baggage by flight number and uses a cathode-ray-tube terminal to display the current flight schedule and baggage counts. A teletypewriter is included to provide printed copy of the displayed data.

As an ultimate backup to the automatic system, all baggage can be immediately shuttled to an area where handlers can sort and route it by conventional means. They would use the man-readable baggage handle strips for identification of flight and destination.

EXTRA-HIGH ENERGY TAPE

Nippon Hoso Kyokai (NHK), the national broadcasting corporation, and Fuji Film, manufacturer of magnetic recording tape, have jointly developed a formulation claimed to give an output four times as high as iron oxide and twice that of chromium dioxide.

The formulation, under development by Fuji Film since 1960 consists of ferri-chrome alloy particles ranging from 0.2 to 0.4 microns in length and 0.02 to 0.04 microns in thickness. The coating of particles bonded in polymer plastic is only 3.3 microns thick. In comparison, a conventional CR02 recording tape coating consists of a surface layer of chromium dioxide 1 micron thick and an inner layer of gamma iron oxide 5 microns thick, a total of 6 microns.

The newly developed alloy formulation can be used for video tape as well as audio.

FAIRCHILD TO MAKE CONSUMER PRODUCTS

The USA's Fairchild group are actively planning to enter the consumer products market, according to a usually reliable source.

Fairchild's first products are believed to be a low-end of the market one-chip hand-held calculator with 8-12 digits. However several industry commentators query Fairchild's ability to produce the necessary MOS chips, quoting Lester Hogan's (president of Fairchild) own description of his company's performance in the MOS field as 'disappointing'.

PHILIPS INTO MEDIUM FX SCOPES

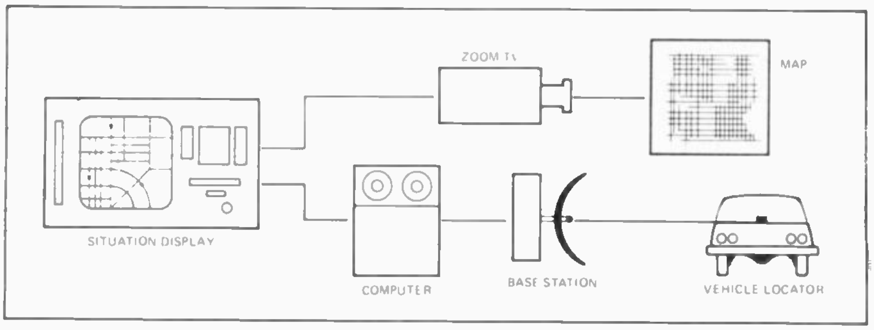
Philips are about to enter the highly competitive medium-frequency oscilloscope market.

A new 120 MHz unit, to be known as the PM 3260 (priced at US$1850) will be released in April. The scope will be in direct competition with similarly priced units from Tektronix and Hewlett-Packard.

An unusual feature of Philips' new scope is the use of 'cold-switching' a technique in which signals are switched digitally by internal circuitry which in turn is controlled by the normal front-panel switches.

A further unusual feature is the inclusion of a switching regulator power supply which enables the scope to operate from 90 V to 250 V at frequencies from 46 Hz – 440 Hz.

VEHICLE LOCATION



A vehicle location system using inertial navigation principles has recently been developed by Boeing (Wichita, Kansas, USA).

Initially planned for police vehicle use, the system can provide the location of up to 1500 vehicles to an accuracy of better than 20 metres.

Surprisingly simple in concept, the system transmits positional information derived from the vehicle's distance recorder and a magnetic heading sensor (compass) to obtain a dead-reckoning indicator.

The transmitted data is received into a centrally located mini-computer (Varian 73) which displays the position of all vehicles on a Sony colour-TV receiver. The display is up-dated every two seconds.

The system, known as 'Flair' has been tested over an 18 month period by police forces in Wichita and also in St Louis.

Boeing believe that fire, ambulance and taxi fleets may also use the system. Projecting into the future the company suggests that interstate trucks could also be plotted – using UHF via a satellite link.

TUNABLE ULTRA-VIOLET LASER

Dye laser combinations provide different tuning ranges

Variable wave-length input (Angstroms)	Fixed wave-length input (Angstroms): Sodium fluorescein (5409)	Fixed wave-length input (Angstroms): Rhodamine 6G (5757)
7-Diethylamino-4-methylcoumarin (4648–4925)	Not tried	1778–1817
Sodium fluorescein (5337–5710)	Not tried	1870–1914
Rhodamine 6G (5680–6111)	1833–1875	1907–1957

Source: International Business Machines

A tunable laser has been developed by IBM (IBM, Thomas J. Watson Research Centre, Yorktown Heights, USA).

Powered by two low frequency lasers, the tunable source can emit coherent light energy far into the ultra-violet part of the spectrum (to 2000 angstroms).

The new laser operates using interaction between two tunable organic dye lasers and a vapour of strontium metal.

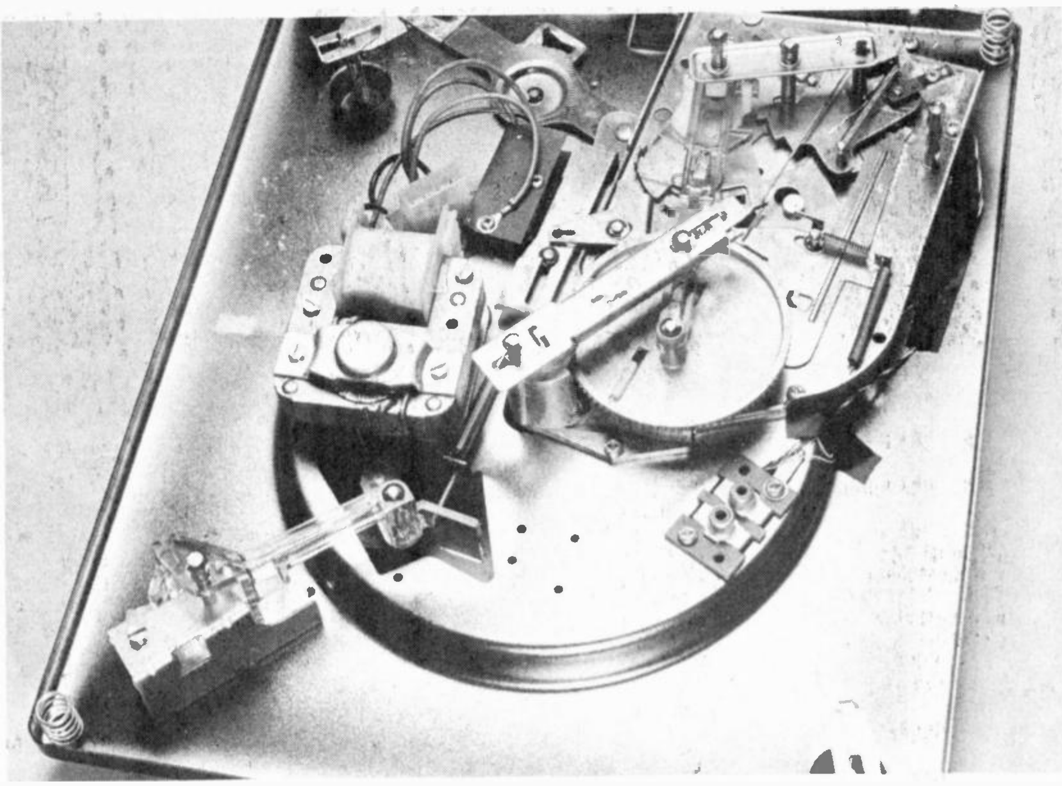
One of the dye lasers is tuned to a frequency that corresponds to half the energy of a particular electronic transition in the strontium atom. An electronic charge cloud of the strontium atom is strongly driven at twice the laser frequency.

Light from the second dye laser interacts with the metal vapour atoms in which the frequencies add so that output light is generated at a new frequency equal to the frequency of the second dye laser plus twice the frequency of the first.

Wavelength selection is then attained by tuning the frequency of the second laser.

At present, conversion efficiency of the ultraviolet sources is small. However output power is several hundred milliwatts, more than adequate for most photochemical and spectroscopic work.

IBM said the new sources permit study, with unprecedented precision, of electronic, magnetic, vibrational, and rotational properties of atoms and molecules, and the manner in which these particles interact in gaining and losing energy.



Design is at the bottom of it all

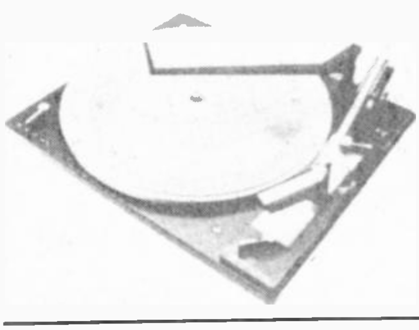
As the newest entry in the record changer market, GLENBURN has combined the time-tested talents of its founder, Dr. D.M. McDonald, with innovative design to develop a revolutionary record changer mechanism.

Utilizing his vast experience as founder and former owner of BSR, Dr. McDonald and his team of engineers were able to develop a record changer which incorporates the most desirable features currently available while avoiding the problems inherent in other mechanisms. Truly better by design, here is just one way GLENBURN has combined experience and engineering talent to your advantage:

To meet the need for a low tracking force as well as a consistent automatic trip at the end of each playing cycle, GLENBURN has developed a light-weight, self-lubricated tripping pawl of Delrin, thereby eliminating the tripping failures experienced with the heavy metal types. This tripping mechanism is not susceptible to the friction caused by burrs, dust or grease that plagues its metal counterparts.

GLENBURN is dedicated to providing dependable performance through superior engineering and design.

GLENBURN – better by design



Each turntable is complete with a handcrafted walnut veneer base, acrylic dust cover, and a Shure magnetic cartridge . . .

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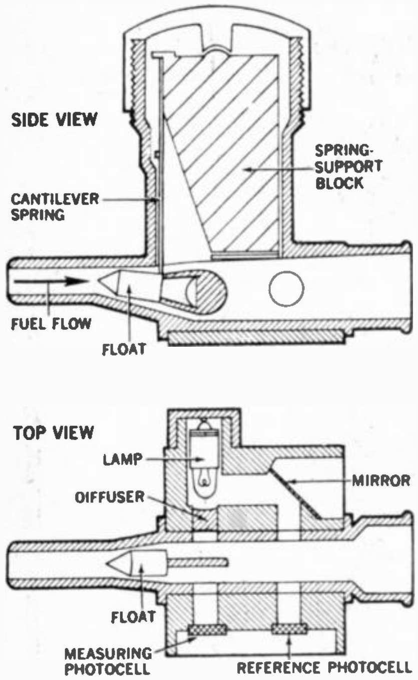
INSTANTANEOUS MPG METER



One of the most difficult quantities to measure accurately is instantaneous vehicle fuel consumption.

Now an ingenious technique has been developed by a British engineering company (Aviatric Ltd, Box 7, Romsey, Hants). Their recently announced three-part unit consists of a meter calibrated in mpg, a flowmeter inserted in the fuel line, and a pulse generator driven by the speedometer cable.

A cone-shaped float suspended in the fuel line is deflected by an amount proportional to fuel flow. The amount of deflection is monitored by a light source and photocell.

To compensate for colour variations in the fuel, changes in light output etc, a second photocell is used in a compensation circuit.

The data from the fuel flow transduce is integrated with data from the speedometer-cable driven distance-transducer to produce an output proportional to fuel miles-per-gallon.

NASA's SPACE PROGRAMME

The US government has released details of its proposed budget for 1975. It includes a grant to NASA of US$3.2 thousand million.

Of first priority for the remainder of the decade is the space shuttle programme, which is now scheduled to launch its first manned orbital flight in the second quarter of 1979. The shuttle will carry men and equipment into space in an orbiting, recoverable satellite. The rocket launchers will also be recoverable and re-usable. In the period from 1980 to 1991 most spacecraft will be launched by the space shuttle, cutting the cost of these projects by an estimated $1 billion per year.

During the shuttle era, some 95% of the spacecraft launched by NASA will be for earth observations and communications. There are 120 communications or navigations satellites scheduled to be orbited before 1992, including 43 for commercial communications within the US. In addition, large, unmanned space telescopes, high-energy astronomical observatories, solar observatories, and radio astronomy observatories weighing up to 12 tonnes will be launched and maintained by the space shuttle crews.

Two new earth observation satellites are included in NASA's 1975 budget for launch in 1977 and 1978. One of these, SEASAT-A, will measure the physical characteristics of the oceans and investigate the utility of such information to the shipping and fishing industries.

The other, a heat-capacity mapping mission, will make thermal measurements of the earth's surface to locate mineral deposits and aid in the construction of highways and canals. This satellite also will investigate the possibility of locating geothermal energy sources by spacecraft.

Continued exploration of the solar system also is planned within the next 15 years. The top-priority project in this area, is a new item in the 1975 budget; two Pioneer spacecraft to explore Venus in 1978. One will orbit Venus close to the surface of the planet to study the characteristics of its atmosphere and map the planet's surface. The other spacecraft will send four probes through the atmosphere from different positions to obtain a three-dimensional picture of the composition of the atmosphere and the forces that influence it.

NASA also has plans to launch two Viking spacecraft to land on Mars in 1976 and two Mariners to fly by Jupiter and Saturn in 1977. In the 1980's as many as 10 Mariner or Pioneer missions to study Uranus, Neptune, Saturn, and Jupiter; two spacecraft to bring back samples from Mars; a flyby of Halley's comet; two lunar polar orbiters; and a communications satellite for the back side of the moon are planned.

POWERFUL NEW SPOTLIGHT

A new, portable, battery-powered spotlight — the brightest hand-held light of its type ever produced — has been developed as a result of arc light research conducted more than five years ago by NASA.

The intense, true colour light beam of the new spotlight has a peak capability of one million candlepower, roughly 50 times brighter than the high-beam headlights of an automobile. The unit should be particularly useful to police and fire departments and to the general public in emergency situations.

Called the Stream Lite-1 Million, the three kilogram light uses a unique xenon lamp with an operating lifetime of at least 200 hours at maximum intensity. Xenon is a heavy, colourless, inert gaseous element.

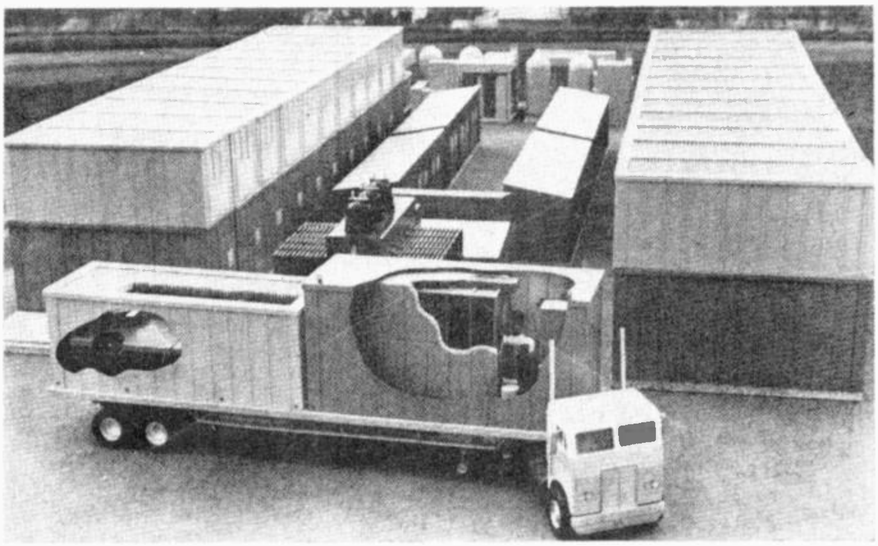
The basic technology for the spotlight stems from a NASA programme for the design of engineering models of a concentric electrode arc needed in spacecraft environmental test chambers.

"The Stream Lite-1 Million can operate in a steady or pulsed light mode. Its intense beam is especially useful in penetrating fog and smoke since it gives off less return light "back scatter." It operates on a standard 12-volt direct current rechargeable portable battery pack or from the cigarette lighter receptable of an automobile.

The new light is being produced by Streamlight, Inc., 123-A Clinton Rd., Fairfield, N.J. 07006. It retails for about $400.

news digest

GIANT FUEL CELL



A 'portable' fuel cell capable of generating 26 MW — sufficient for a city of some 35,000 people — is being developed in the USA by Pratt / Whitney Aircraft Corp in conjunction with a number of electricity supply companies.

The cell is built as a number of vehicle-transportable modules.

Fuel to be 'burnt' in the cells can be hydrogen, carbon monoxide, methane etc. The electrochemical conversion process is claimed to be approximately twice as efficient as conventional turbo-generators, and is virtually pollution-free.

JOVIAN ATMOSPHERE

Jupiter's atmosphere contains ethane and acetylene, according to observers at Kitt Peak National Laboratory.

Their detection follows earlier predictions that the compounds are formed in photochemical reactions. The two compounds probably are confined to the outer atmosphere by a temperature inversion.

Hydrogen was identified in Jupiter's atmosphere in 1960 and both ammonia and methane in the 1930's. Kitt Peak observers speculate that, with infrared detectors of high resolving power, ethylene also probably will be found.

MASSIVE IMAGE ARRAY

A half-million element optical scanner has been developed by IBM. Using standard MOS fabrication methods the device is built on a mammoth 1050 x 1600 mm chip.

Intended for facsimile applications, copy to be transmitted is focussed onto the surface of the chip. Then, the charge is removed from the device by conventional bucket-brigade shift-register circuitry.

42 KM WAVEGUIDE LINK

A millimetre wavelength communication link is about to be installed between Heidelberg and Darmstadt in West Germany.

The waveguide system is unusual in that the 500,000 voice channel link has such a low loss that no repeaters at all are required over the entire 42 km link. (A normal co-axial cable link would require at least 25 repeaters to cover this distance).

4-CHANNEL CHIPS

Our correspondent in Japan reports that the Dorren QSI-5022 CD-4 integrated circuit will be available to equipment manufacturers in May. Price is believed to be under US$6. The Dorren chip is manufactured by Matsushita Electric.

The Victor Co (JVC) confirm that Signetic's CD-4 chip (CD4-392) will definitely be available before April. Our correspondent understands that JVC intend to offer complete demodulator boards (each containing two CD-4 IC's) to consumer equipment manufacturers worldwide.

SPACE LATEST

A joint US-European space venture has recently been proposed by officials of the US space agency NASA and its European counterparts.

Projects under discussion include a joint mission to Jupiter and a possible flight, in 1980, to the comet Eake.

Both proposals involve the use of the now redundant back-up spacecraft for NASA's two Jupiter Pioneer missions.

Two alternatives are under discussion for a Jupiter venture. The first involves launching in 1978 — encountering Jupiter in 1980 — on a trajectory towards the Sun.

The second proposal is for a less-costly Jupiter orbital flight.

Further space news is of a possible (unmanned) mission to Mars (probably in 1979 or 1981) in which a Mars Rover vehicle would be used.

The basic design of the Mars Rover is a 100 kg vehicle carrying a payload of 40 kg. Capable of travelling up to 45 km the vehicle would also be used in unloading operations.

The Mars mission is predicated on the use of spare parts left over from the planned 1975 Viking mission to Mars.

The 1975 missions involve two landers and two orbiters. A third lander is being built as a back-up — it is this unit which, if all goes well, will be used in 1979.

FM INQUIRY — UNEXPECTED EVIDENCE

Observers at the recent inquiry into FM radio confidently expected the Australian Electronics Consumer Industry Association (a trade association of consumer industry heavies) to support the use of the UHF band for Australia's proposed new FM system.

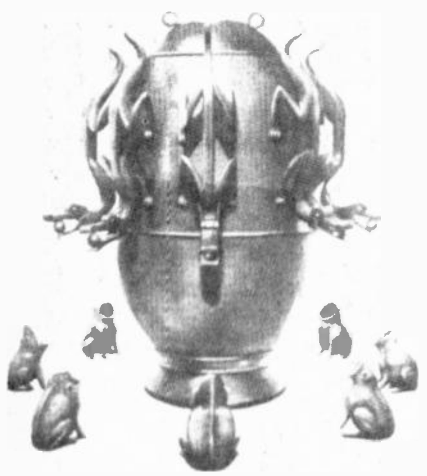
In a surprise move, the group's normal spokesman, R.W. Tremlett of Philips, said that the Association would not give evidence.

Possible indication of a split in attitudes within the association was evidence given subsequently by GE, who through their manager of product planning, A.N. Scovell, stated that they did not support the proposed use of the UHF band.

In their evidence they stated that 'for Australia to opt for the UHF band — untried and totally incompatible with overseas technique' — would be 'yet another in a series of examples of the Australian electronics industry insulating and protecting itself through technology'.

AWA, on the other hand continued to assert that the UHF band was not only feasible but indeed preferable to UHF.

WHAT WAS IT –



(See page 62, this issue)

SEA AS AN ENERGY SOURCE

United Engineers and Constructors, Inc., a Raytheon subsidiary, will evaluate the sea as an electric power source, under a contract with Solar Power, Inc. (York, Pa.)

United Engineers plan to use temperature differences between the ocean's warm surfaces and colder depths – sometimes as great as 40°F. These differences provide conditions needed to boil and condense thermal fluids such as propane, which, in a pressurized vapour state, could run a vapour turbine generator. Though capital costs are high, fuel costs are about zero; in addition, there is no air pollution or solid waste, and thermal pollution is very low, say the company.

UNIVERSITY OF SYDNEY TO USE COMPUTER FOR SPEECH RESEARCH

Many experiments with human beings, in fields ranging from physiology to perception, are involved with real-time in the collection of data, the simulation of some aspect of human behaviour or functions, or the reaction of human beings to external stimuli. A computer system used in experiments of this kind must be able to acquire and store data as events occur, to display data or parameters showing their relationship to real-time, and to operate external hardware through suitable interfaces. In this latter respect the computer is sometimes required to function interactively so that the experimenter or the subject can modify either data or the program during execution, as a result of observing or reacting to computer output or other events, during an experiment.

One of the most complex fundamental and distinctive activities of human beings is their ability to communicate by means of a highly developed language facility. Research into speech is generally motivated by an interest in the mechanisms of language, and it is speech and the perception of speech which have proved to be the most accessible aspect of language for experimental investigation.

The phonetics laboratory at the University of Sydney has ordered from Digital Equipment Australia Pty Limited, a computer system to provide facilities for staff and postgraduate students to conduct research into speech. The new system is expected to greatly extend the research facilities which the laboratory can offer. The system consists of a GT40 graphic display based on the PDP-11/10 computer which operates interactively through the display unit, using a light pen interrupt supplied with the GT40.

The system will function as a data gathering storage device with CRT display of data and provision for the interrogation of displayed data by a light pen or joystick-controlled cursor, to yield data values at any point selected in the X-Y display. The data sources will be mainly acoustic, but may also be physiological. In some applications, dedicated analytical equipment may process the raw data to give more meaningful parameters before acquisition and storage. The computer will also be used to control devices for generating stimuli, the most complex of these being a terminal analog speech synthesizer designed and built at the phonetics laboratoy. The synthesizer requires twelve time-varying control parameters, and is capable of producing quite intelligible speech for experimental purposes.

The PDP-11/10 will have a cartridge disk unit, which not only has functional advantages for the system, but will also allow the acquisition and retrieval of much larger quantities of raw data, such as the direct recording of acoustic speech signals for electronic editing or selective analysis, with a versatility and a precision far beyond that of an audio tape recorder.

news digest

STC MAJOR ORDERS FOR MICROWAVE LINK EQUIPMENT

Following the success of microwave radio link equipment supplied by Standard Telephones and Cables Pty. Limited for the Bathurst 1000 race meeting at the Mount Panorama circuit, the Channel 7 networks in Sydney and Melbourne have placed orders, valued at $240,000 for the equipment.

The portable microwave outside broadcast links will be used by both stations for the transmission of colour and black and white pictures.

Main use for the microwave radio links will be for sport coverage, transmitting the picture directly from the sporting event back to the studio for relay throughout the network.

However, in addition to sporting fixtures, such as race meetings, football, cricket, etc., the O.B. radio links will also be used for "live" on-the-spot news coverage.

The STC radio link equipment will be used in conjunction with new Colour O.B. Vans recently purchased by HSV and ATN.

The O.B. link used was designed for the 625 line colour television service proposed for Australia. It operates in the frequency band 7.1 to 7.4 GHz.

A number of optional features are available including an additional sound channel to cover the occasions when two separate sound commentaries are required to accompany the picture information. This occurs when two T.V. stations decide to pool resources by taking a common feed of video but require their own sound commentary and on occasions when the programme is destined for an overseas network with one sound channel not in the English language.

FIBRE-OPTICS COMMUNICATIONS

Fibre-optic communication systems may be closer than you think.

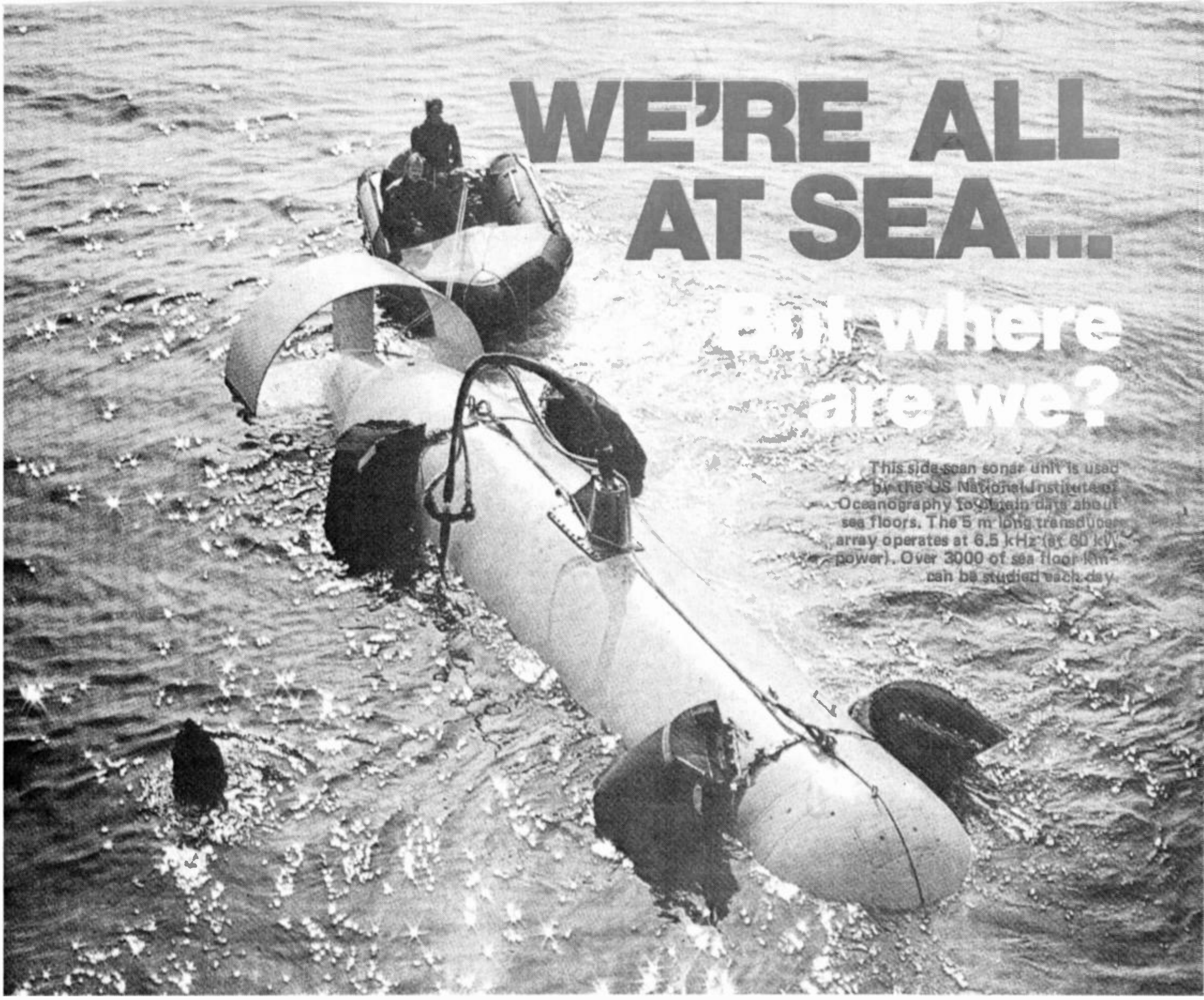
A telephone system using this new technique has been developed by the US Navy's Naval Electronics Laboratory (San Diego) and installed aboard the US flagship USS Little Rock.

Full details are of course not available but the system is known to consist of six telephone stations and a central switching exchange.

Voice signals are converted by an LED into a frequency-modulated digital light pulses which are then carried by bundles of fibre-optic materials via the central exchange.

WE'RE ALL AT SEA...

But where are we?



This side-scan sonar unit is used by the US National Institute of Oceanography to obtain data about sea floors. The 5 m long transducer array operates at 6.5 kHz (at 60 kW power). Over 3000 of sea floor km² can be studied each day.

In recent years, man has taken to the seas as never before. In the second — and concluding part of this feature article Dr. Sydenham deals with sub-surface operations.

VISUAL means of measuring distance and position under the sea are not satisfactory because the visibility is too poor.

With ocean depths running to many kilometres, the 50 m or so that daylight penetrates is relatively insignificant. Even at the bottom of the Continental Shelves (where most of the present underwater human activity takes place) artificial light is necessary.

With the exception of VLF radio transmissions (which lack adequate precision anyway for most sea floor work) radio location methods are of no use, as water rapidly attenuates the signal.

Fortunately acoustic waves, in contrast to electro-magnetic waves, travel well in water so radar-like principles can still be used, but with different hardware. Furthermore, the acoustic velocity of waves in water is considerably slower than that of electro-magnetic propagation so it is possible to gain finer detail of structure and position — the problems of interval timing are not as severe at the reduced velocity.

Positional sensing devices are needed in oil-drilling control, in hydrographic surveys where the sea floor is charted, in fishing, in exploration and in military operations. Decompression and compression effects alter rapidly due to the high desnity of water compared with air and any man or machine venturing well below the surface needs to know the depth if only for reasons of safety. Many undersea measurements can be made from the comfort of the surface — others must be made from below.

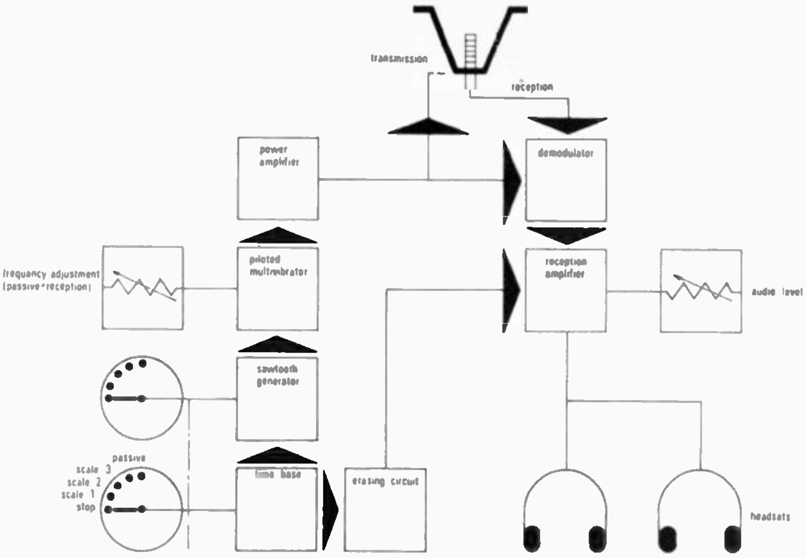
Acoustic Sensors — The basic elements of a sonic underwater ranging or communication system are the transmitter transducer that sends out the acoustic signal; a receiver (which may be the same transmitter transducer) and a data processing and display system — see Fig. 1.

Most systems operate in the ultra-sonic region making use of electric spark discharge, piezo-electric or magnetostrictive modulation methods to couple electrical energy to the water medium as acoustic energy waves. Various names are in use — echo sounders, sonar (short for sonic radar), hydrophones and acoustic sounders — there is little specific meaning in each.

Sonar ranging systems use the same principles as electro-magnetic radar — that is, they may measure the time of flight of a pulse or they may use continuous wave methods.

The Freid Krupp Atlas-Elektronic echo-sounder operates simultaneously with 30 kHz and 210 kHz carrier frequencies to cover the depth range from zero to 300m.

The varying velocity of sound waves in water limits the accuracy of sonic methods to about 0.1 percent and 18



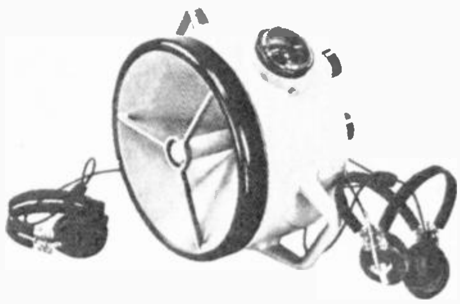


Fig.1. Schematic and actual photograph of the Thomson – CSF portable sonar used by divers to locate obstacles whilst underwater. The unit uses a reflector cone of 140 mm diameter to enhance the gain.

switched ranges are used to obtain resolution at the respective depths.

This system can resolve increments down to 50 mm, depending on range, sending the sounding pulses of carrier at 60 per second. The higher frequency in this system is for charting the upper surface of the sea-floor mud, the lower frequency penetrates as deeply as 8 m down into the mud.

Many sonar devices now include a display that provides a picture of the sea bottom. Depending on the type of sensing arrangement, this will be either a cross-sectional profile or a plan view.

If the sensor is hull mounted the ship's noise, especially while the ship is under way, will seriously restrict the attainable resolution. More sensitive systems, for example the E,G & G side-scan sonar have the sensing transducer in a towed hydrodynamic 'fish' that hangs as much as 600 m down. In this side-scan device the 'fish' transmits short acoustical bursts of carrier at right angles to the path of movement: the beams slant slightly downwards to impinge on the bottom below. Time interval differences between sent and received pulses enable a picture of the bottom to be built up on a ship-mounted display. This display is clear enough for fine sea-floor detail to be studied out to 450 m on each side. (See Fig. 2).

Seismic sounding is another acoustic method. This is used to explore the structure, rather than surface details, of the rock and mud below the floor. Explosive charges, compressed air releases, spark discharges and other methods propagate a soundwave down into the floor. (Explosives used range in size from tens of grams to tens of tonnes). These waves eventually emerge out of the rock because of reflections from the interface of rock layers or from diffraction effects that curve the rays. Arrays of floating or floor-placed hydrophone pickups detect the emergent sound waves. The strength of the signal and its arrival time at each sensor are then combined with the known acoustic wave velocities to give a cross sectional picture of the structure being studied. The example shown in Fig. 3. is part of a survey of the English Channel made for the Channel Tunnel project.

Acoustic methods are also used in

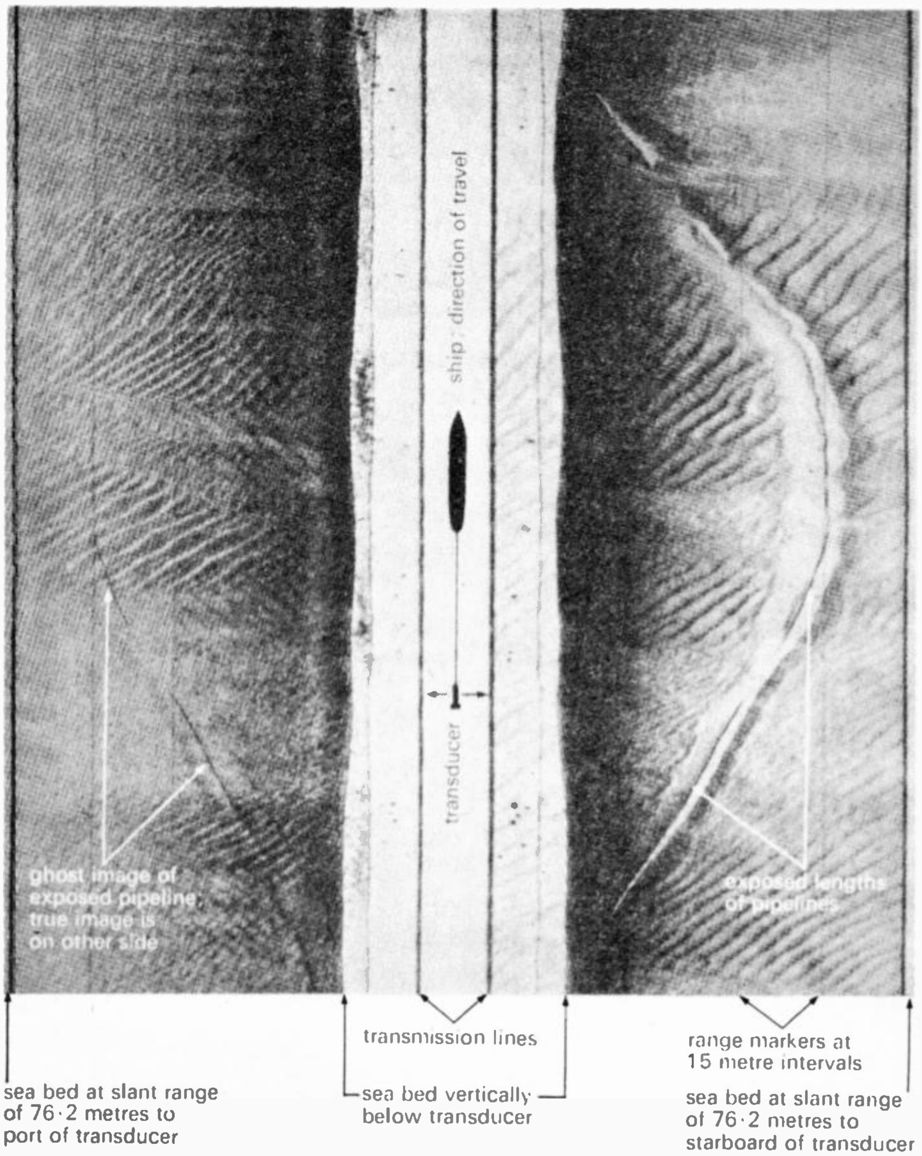


Fig.2. Side-scan sonar was used to provide this view of the sand floor in which the sandwaves and an exposed pipe-line can be seen.

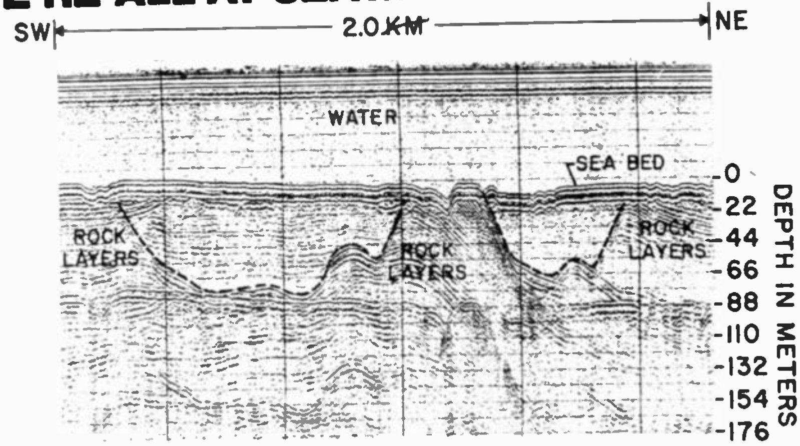


Fig.3. Seismic sounding enables the cross-section of sea floor structure to be obtained.

the search for underwater objects. In one military system, a listening head is lowered into the water from a helicopter. Figure 4 shows a piece of commercial equipment. This is a scanning sonar that is lowered on a cable. Its sensing head rotates to view a circle perpendicular to the cable; a 1 m sphere can be detected at 120 m range, an acoustic marker at 500 m.

Acoustic markers are active devices deployed at a datum point — they transmit a closely omnidirectional, equal intensity acoustic carrier. The Thomson-CSF 7011 unit sends out 50 ms bursts of 38 kHz each 0.5 s. Its battery pack operates the marker for 10 days. The Thomson 7021 unit operates for six months unattended.

As with radio-location methods, some acoustical methods make use of transponders. This technique reduces the battery drain, as the transponders only transmit at full power when instructed to by the incoming energy.

Divers use acoustic markers for relocation. A more spectacular use is in deep sea drilling. Here they are used for automatic control of drill string position when re-entry into the bore-hole is required.

Around 1965 it was decided that much scientific information would be obtained if core samples could be taken from the deep sea-bed floor. An oil-drilling rig — renamed the Glomar Challenger — was converted for this purpose and was put into service sampling line after line across the sea floor.

To collect these samples, exploratory holes must be drilled in the sea floor at water depths of 7 km. It is not hard to visualize the difficulties of such an undertaking. For a start using a seven kilometre long supported drill string of just some 150 mm diameter is like feeding the end of a long piece of cotton into a needle hole that can't be seen. The drilling rig must remain above the hole during drilling regardless of sea state and it must be possible to reinsert the end of the drill string into the hole with reasonable ease.

Sonar is used to re-enter the bit into a 5 m diameter concrete cone that sits on the sea bottom. Acoustic sensors, mounted around the edge, provide signals to power the string thruster (a water-jet from the side of the string at 20 m up from the bit) until the bit is over the cone.

Commercial companies have since developed somewhat similar systems for use in shallower water. A re-entry sonar unit by Thompson-CSF, is shown in Fig. 5. Their system eliminates the entry cone to the well head and lessens the chance that the string or drilling operation will damage the sensors. The unit is set on the bottom near to the hole and the rotating search sonar gives a panoramic display of the sea-bed. The surface operators can then manoeuvre the ship accordingly. The small cone at the top is the outlet of a taut-wire inclinometer (discussed later in this article). The unit will operate in depths to 300 m enabling its surface operators to see out to 80 m.

Undoubtedly acoustic methods are at present the most powerful means available for seeing underwater. Few vessels can do without one form or another.

To round off this description of sonic methods let us look at what is probably the biggest acoustic 'fish' yet made. This is the Geological Long Range Asdic (GLORIA). It was built by the British National Institute of Oceanography at Guildford for making side-scanned sonar maps of the bottom. The device is 50 m wide, some eight tonnes in weight and 10 m long.

It is towed at 10 knots at a depth of 200 m. Inside are automatic steering

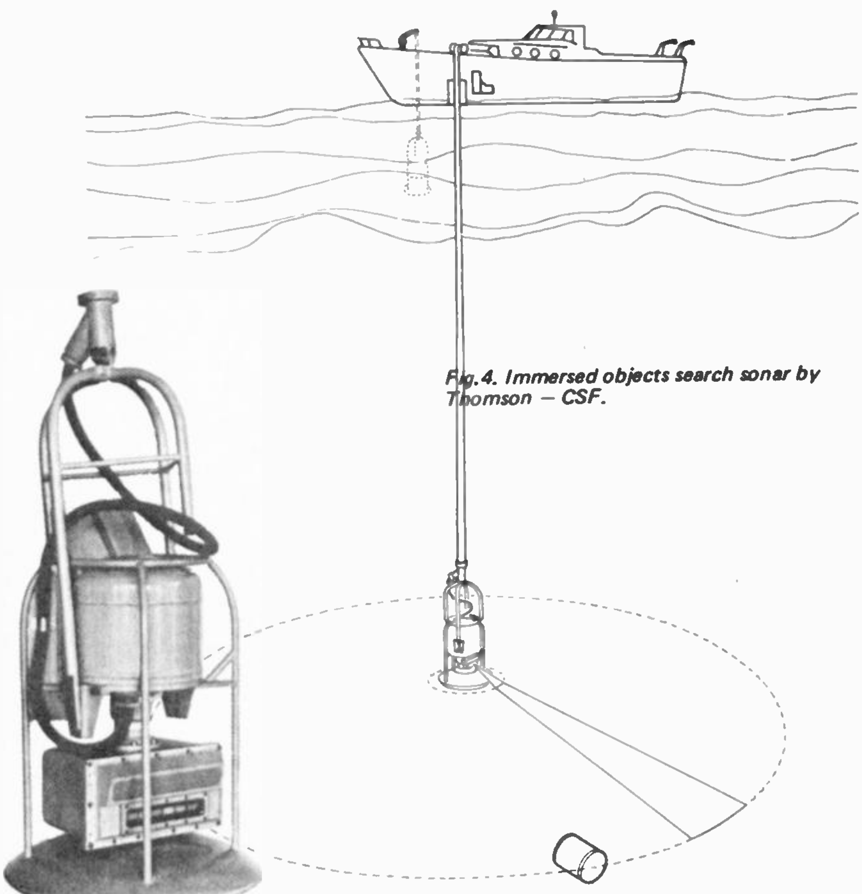


Fig.4. Immersed objects search sonar by Thomson — CSF.

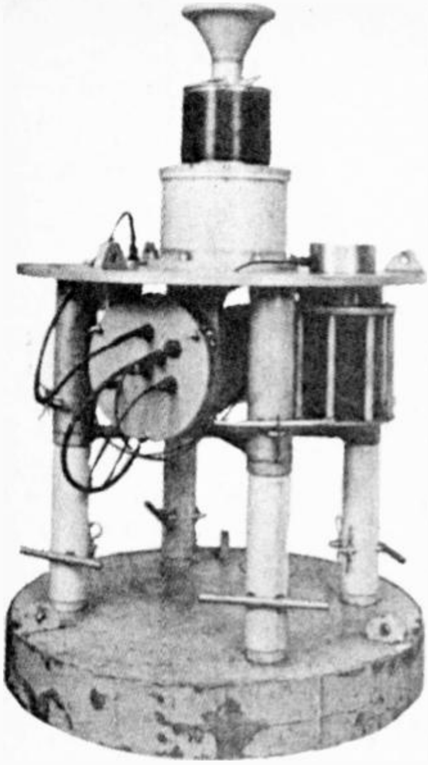


Fig.5. Acoustic methods of measurements make it possible to thread e drill-string into the bore-hole by remote control from the ship.

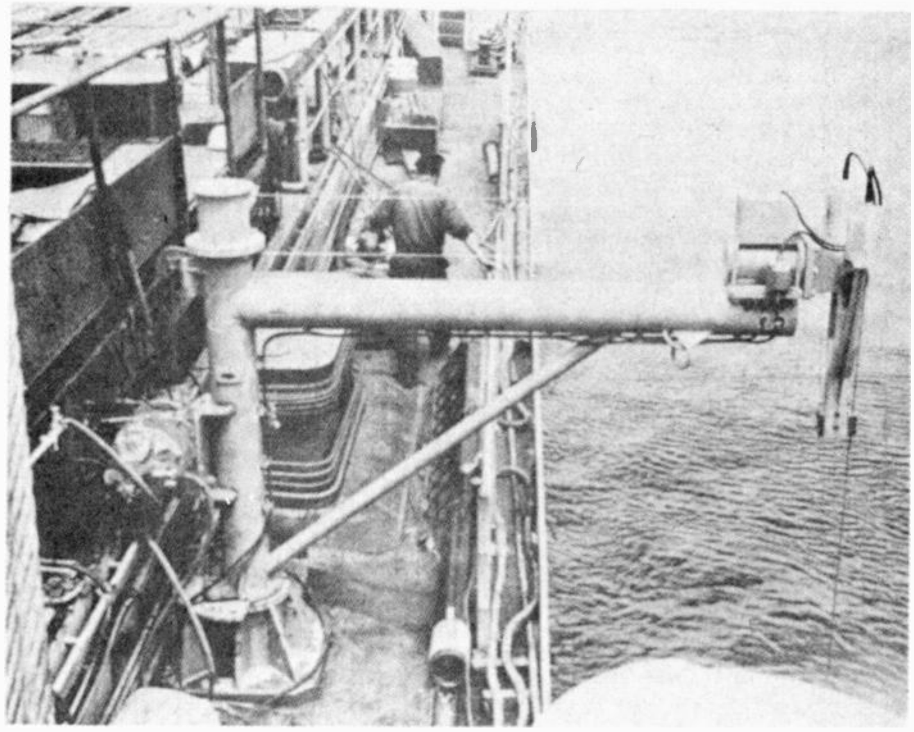


Fig.6. Inclinometer control of ship position. The cable goes to a bottom location and is held tensioned. Inclinometers measure the tilts of the wire in each horizontal direction.

units to control altitude and depth – a map would be meaningless without control of the direction of the sensors. One hundred and forty four transducers look out 20 km each side. With a maximum design depth of 9 km this device should add considerably to our knowledge of the sea floor.

Underwater acoustics are versatile but other methods often provide a more economical solution or solve a problem outside the capability of sonar.

TAUT WIRE INCLINOMETERS

Possibly the easiest way to locate position on the bottom from a ship is to stretch a wire between both points, using its length and angle to the vertical to relate the two.

TSM 9101 is the code number of the Thompson-CSF inclinometer used in oil well drilling. It is shown installed on 'Toucan' in Fig. 6. A five to 10 mm diameter high-tensile cable is secured to the bottom with a dead-weight (the sonar re-entry unit mentioned earlier, for instance). The shipboard end is held under constant tension by an electric winch which has automatic control over the pull exerted. Outboard from the hull, where the cable enters the water are the inclinometer units in which two damped pendulums (driving transducers) monitor tilt in mutually perpendicular directions. This method is not as accurate in defining position as some sonic procedures but suffices to hold the ship (using feedback control – see later) within a cone of diameter of five per cent of the depth; the sensors measure to within one per cent. Greater accuracy would require corrections to allow for the catenary shape in which the cable hangs when not truly vertical. This has been investigated by a North American team.

TELEVISION

Another way to position objects is to lower a television system and lights so that relative positions can be seen from the surface. OCTV has been used to look into drill holes, to drop grabs when a worthwhile bite can be made, to close fish nets when a shoal swims in.

The ill-fated 'Thresher' submarine was finally identified this way in 1963 but even before that this method identified the underwater wreck of the 'Affray' – back in 1951. You probably remember the saga when the US Airforce lost an H-bomb off the coast of Spain in 1965. The remote-controlled submersible CURV was lowered to find and retrieve the bomb. Television and sonar sensors were used in the operation.

Recent advances in low-light television have greatly improved the seeing power of CCTV in underwater exploration.

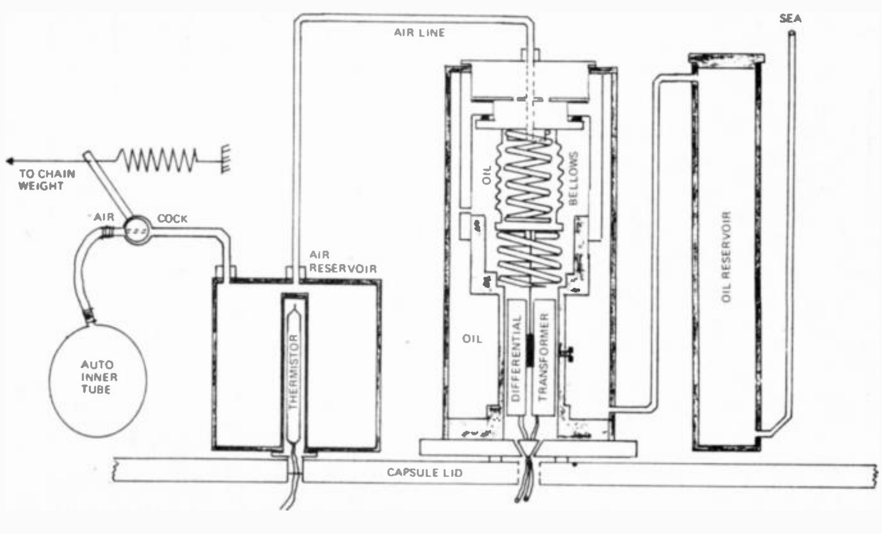


Fig.7. Basics of a differential-pressure sensor designed to monitor wave heights.

WE'RE ALL AT SEA...

FREE-FALL CAPSULES

So far we have looked at methods that are tied, either physically or by an information carrier link, to the mother ship. Another class of devices are released from the surface to fall freely — collecting data during the descent, or when in position at the bottom.

These are particularly useful for extended periods of measurement as it is costly to keep a surface vessel in place for a long time. One example is the measurement of wave and swell heights when records of many months duration are needed and measurements often must be made in quite inaccessible places.

Two methods are used for collecting the data transmitted by the capsule. The capsule may have an acoustic data link to a surface buoy and the data is retransmitted from there, or, as is more common, the capsule will contain recorders that are interrogated upon retrieval of the capsule.

Recovering a free-fall capsule requires some ingenuity. Some capsules have an inbuilt time-switched trigger to float them back up at the right time. In others a surface-sent sonar pulse activates the flotation device. Still the loss of free-fall capsules is a major problem. Even tethered capsules go astray.

WAVE HEIGHT MEASUREMENT

It is difficult to measure wave-height from a surface location for there is no stable-altitude platform from which to measure the height changes. The Air-borne laser terrain profiler can provide a measure but is not the most economical way if wave-height time variations at a fixed point are needed over long periods. Instead, it is easier to make use of a sensitive pressure-gauge that monitors sea floor pressure; the height of water at any moment governs the hydrostatic pressure below.

In wave-height meters the design must incorporate automatic pressure balancing to counter the absolute pressure as the device descends. In the Horace Lamb Centre system, shown in Fig. 7, the tyre inner tube compresses with depth producing a pressure balance between the inside and outside of the measuring bellows. When the end of the hanging chain touches the bottom it reduces the weight on the valve shutting off the air-cock. The differential-pressure transducer is thus balanced on each side at the ambient pressure and is then ready to record the small pressure changes brought about by the changing water-head.

Absolute pressure is, of course, a measure of absolute depth and this principle is used to gauge depth — in the same way as the aircraft altimeter measures height. The design of depth gauges is, however, quite different from that of altimeters for sea pressures run to kilograms per square millimetre. Skin divers use small wrist-watch size pressure gauges to give them a depth reading.

HOLOGRAPHY

Holography is a universal method capable of utilizing any coherent wave source and is now being adapted for use in sea-floor mapping. The object of interest is illuminated with a broad wave-front of coherent acoustic radiation. The subsequent reflections are received at the surface where they are mixed with coherent radiation taken directly from the source. An interference pattern is created where they meet on the surface. This is the hologram (the name usually associated with laser radiation) or phasigram (for acoustic holography). The plane hologram contains enough information for the scene to be recreated as a 3-D image — achieved by looking through the hologram at a similar coherent source.

Acoustic holography seems best underwater, for the coupling and attenuation problems are less than at other radiation wavelengths. This is, however, not necessarily so. Laser radiation, especially at green wavelengths, is also suitable. The earlier preoccupation with sonic methods has led to greater experience with acoustics but recent events now show laser methods to be applicable in water.

In the sonic technique, use has been made of an oil film on the surface that forms in a 3-D shape related to the acoustic interferences. This can then be recorded as an optical hologram using laser radiation. Still water is, however, essential so other workers are researching the use of scanned signal or multiple hydrophones as a way to record the phasigram in a moving surface situation.

Both methods are still in their infancy but in this decade we can expect to see holography used to produce reconstructed pictures of the sea floor, thus giving still more alternative methods with which to study the underwater world.

CONTROL OF POSITION

Having seen how we can determine position and produce a control signal, it is appropriate to conclude with a quick look at automatic positioning techniques used at sea.

Automation requires first a position sensor, then instrumentation to process the positional and time data and produce the error signals which drive the vessel's manoeuvring system. The final requirement is devices to produce thrust in a particular direction.

Automation can be used either to guide a moving vessel (navigation) or hold a vessel stationary (dynamic positioning).

AUTO NAVIGATION

Provided the input to a rudder accepts the form of signal produced by the processor, and a rudder position-feedback transducer exists, then auto navigation can be arranged by assembling the various units as illustrated in Fig. 8. Radio location methods can be switched into the system to give actual position data; the system will also work from a magnetic compass output or a gyro unit. The auto-pilot unit accepts the positional data, compares it with the desired position data and produces an error signal if there is a difference. The steering gear is then driven accordingly to reduce the error and hold it close to zero. A rate-gyro is also incorporated to assist turning operations — it provides a precise short-term directional reference.

Several manufacturers offer facilities that automatically plot position (to the appropriate map-scale) as a course is followed. These can be used as a check of the autopilot or as a manual

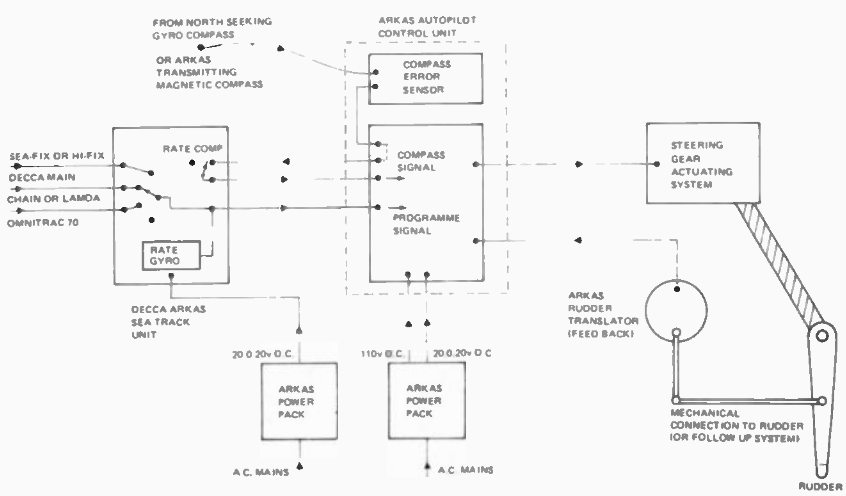


Fig.8. Automatic steering control system using Decca modules.

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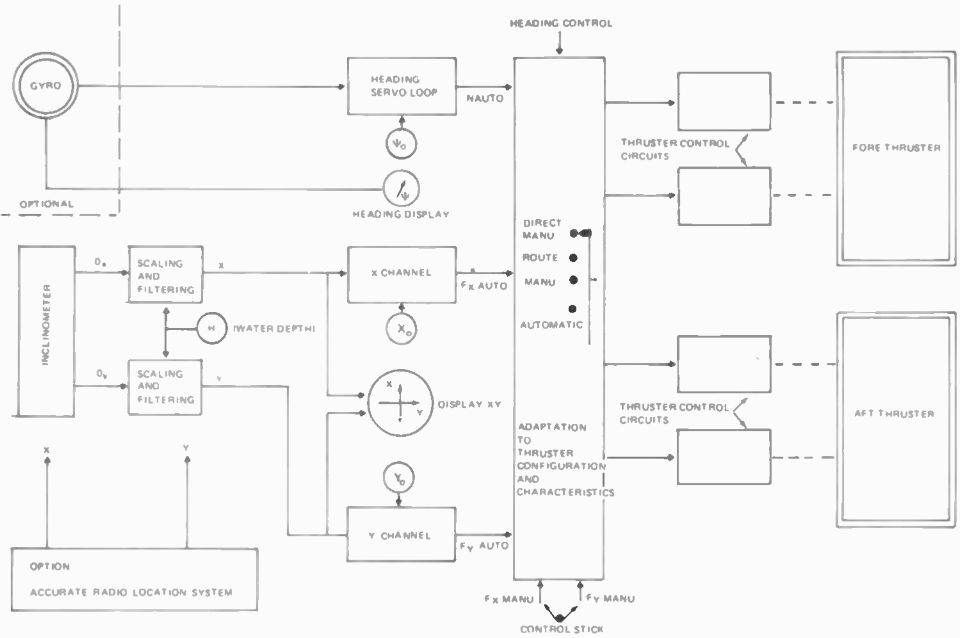


Fig.9. Block diagram of system, based on the taut-wire inclinometer, to hold a ship in a constant position regardless of sea-state.

aid to semi-automatic navigation. The Del Norte equipment, for example, has a general-purpose processor to convert navigational instrument signals into a form compatible with a programmable desk calculator having a coupled x-y plotter. This equipment also provides left/right steer indication for manual control.

In hydrographic survey the aim is to chart the sea-depth in order to plot maps. It has been suggested that the use of a number of slaved sounding launches covering the area around the mother ship would be advantageous. One institute has already built a remote-controlled unmanned launch to test the feasibility of the concept.

DYNAMIC POSITIONING

In the main, it is the oil rigs that need motion stabilisation. Consequently many drilling ships now have advanced position-control mechanisms. As the vessel is not making way, rudder control is not applicable. Instead oil rigs use thruster units, placed fore and aft in the hull. These may be water jets using pumps or additional, conventional, propellers; in each case their compounded effect can thrust the ship sideways as well as forward or backward. Having many more variables of thruster control than the simple rudder (for example, there may be four units each having variable power and direction in a full circle) the processor of this kind of control is more complex. Not only must the position be held constantly but in many cases the heading must also be maintained to reduce rolling in heavy seas.

The exploration ship 'Terebel' of the Institut Francais du Petrole had this control fitted in 1964; since then many other ships have been fitted out in this way. The latest is probably the 'Pelican', fitted with the Thompson-CSF system (illustrated in Fig. 9). A taut-wire inclinometer (or radio location system) provides x and g inputs to the processor from which error signals control the thrusters. In some 1968 tests with this equipment the 'Terebel' was positioned to within 2 m at a depth location of 40 m with the sea-state at 4 m high waves. In quieter seas it controlled to within a metre.

It can be seen that positioning at sea is a vital problem and that numerous solutions have been developed. What the future holds is hard to predict — already it has been demonstrated that an airbome laser ground-profiler can see down many fathoms to, in fact, profile the sea-floor. Coupled with the scanner principle the elements of a rapid sea-floor mapping method appear. This is currently being investigated in Australia.

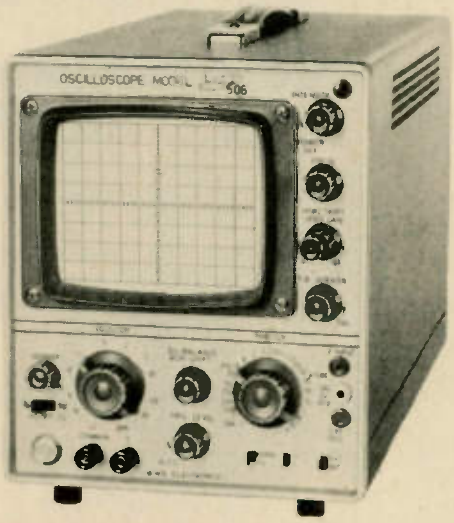
Laser light-houses all round the coasts may have modulated beam information giving a ship's master his position to within centimetres when he views the light-house with special binoculars. The revolution in equipment size and reduced cost that integrated circuit technology has brought to bear will undoubtedly alter the scene as yet another special-purpose LSI chip is developed.

One thing certain is that we will soon see ships travelling as remote unmanned slaves to a master vessel.

Later should see the advent of unmanned ships navigating themselves across the globe. Just *when* these ideas become economically viable is the question. Our technology can cope already — the great cost of high reliability and the attitudes of labour organisations are our current limitations. ●

D.C. TO 15MHz 5mV/cm

b.w.d 506



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Sensitivity:	.6V to 6V/cm
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Trig. Facilities:	AUTO, Level select, Int and Ext.
Horz. Amplifier:	DC to 1MHz
Sensitivity:	.6V to 6V/cm
Z Modulation:	20V pos. blanks trace at norm inten.

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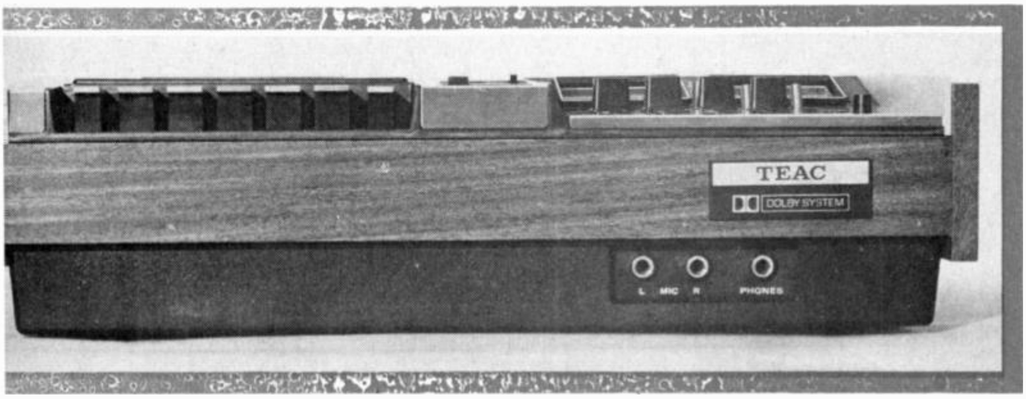
TEAC A-360 CASSETTE RECORDER



Latest, improved version of TEAC's highly successful A-350 unit.

JAPAN'S Teac Corporation have earned a worthy place as one of the world's leading manufacturers of hi-fi equipment – particularly cassette recorders.

The company's Teac A-350 (reviewed in ETI, January 1972) has deservedly been one of the best selling machines for the past two years.

But as, with any good product, improvement is generally possible, and we were not surprised to see an improved version of the Teac A-350 released as the Teac A-360.

One of the major problems that have plagued many cassette recorder manufacturers has been excessive wow and flutter. The Teac A-360 is an exception. It is one of the few machines on the market which has a wow and flutter performance comparable with a good reel to reel recorder.

The Teac A-360 has many similarities in appearance to the A-350, the most significant difference, being the relocation of the tape counter and the tape run indicator light, and a very much improved piano lever key control system. This is now colour coded to simplify identification of major functions.

The designers have also incorporated separate bias and equalisation switches as well as an MPX filter to remove the residual carrier when an FM stereo broadcast is being recorded. (This latter facility may well be of value in Australia when FM broadcasting is introduced).

Whilst the top panel of the A-350 contained more plastic than metal escutcheons, the A-360 looks more solid even though it contains just as much plastic! This has been achieved through the extensive use of a brushed satin aluminium overlay which is divided into two areas around the cassette well and over the secondary controls mounted in front of the two VU meters.

The A-360 has a much cleaner, and, to use a hackneyed expression, professional look than the A-350. One minor objection to the restyling is that finger marks show up on the polished surface necessitating regular cleaning with a soft rag.

The new style piano lever key switches in front of the cassette well are much more sensibly positioned and separated than on the A-350. Ergonomically the unit was easier to use without lengthy familiarisation. The main piano lever key controls are, from left to right:– eject, which doubles for opening the cassette well cover by half depressing it; record lever; fast rewind; play; fast rewind; stop; and a pause control which has a sensible locking position (which most of the manufacturers are now accepting and incorporating).

To the right of these controls, at the front of the cassette deck is a three-digit counter with a reset button and a tape run light. Beside this is a memory on-off switch. The major use of this facility is that where you desire to cue back to a previously noted position, it is only necessary to depress the counter to zero and on the fast-rewind the memory switch will deactivate the drive system as soon as the counter reaches zero.

The right hand side of the top of the deck incorporates the two VU meters at the top — which for once used the standard VU colour system of yellow — instead of the more typically Japanese black, which makes meter reading difficult. Between the meters are two light emitting diodes (L.E.D.s), the upper one indicating transient over-recording (over-modulation) on record, the other showing that the machine is in the record mode.

Below the two VU meters are five toggle switches. These are, respectively from left to right, a bias switch with three levels of selection — for chromium dioxide, high energy gamma ferric oxide, and standard tapes. The third switch is the programme input selection for microphone, DIN plug, and line inputs respectively; the fourth, the MPX filter selection switch; and the fifth selects the Dolby noise reduction system.

The controls for input recording level and line output level are separately provided through two pairs of slider potentiometers. Power is selected by an on-off pushbutton.

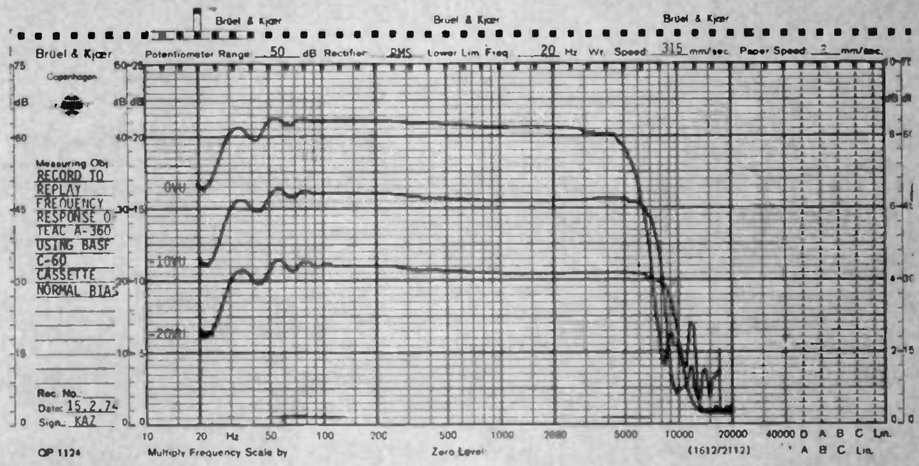
On the front of the cabinet, below the Teac label, are two standard microphone tip and sleeve sockets, and a standard tip ring and sleeve headphone socket for monitoring tapes without the need of a separate amplifier.

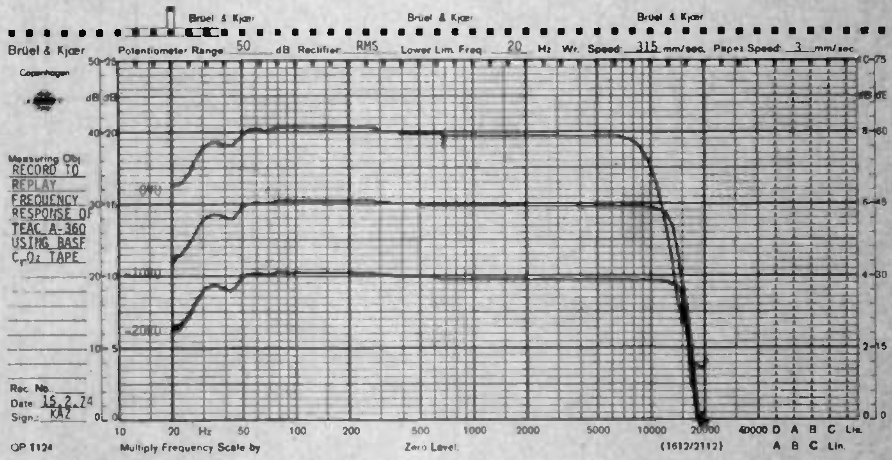
The provision of two separate switches for bias and equalisation seems pointless. These functions could equally well have been catered for by a single lever switch. Even the chart presented in the handbook giving recommendations for the positioning of these switches, provides no justification for their separate provision.

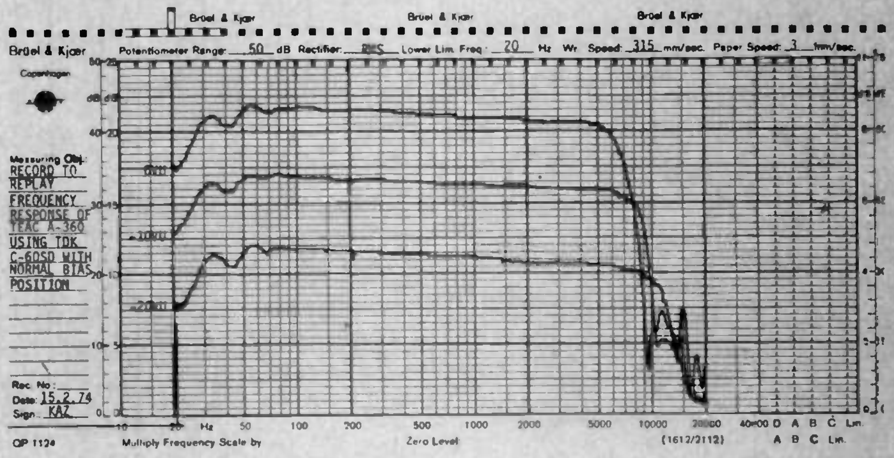
INTERNAL CONSTRUCTION

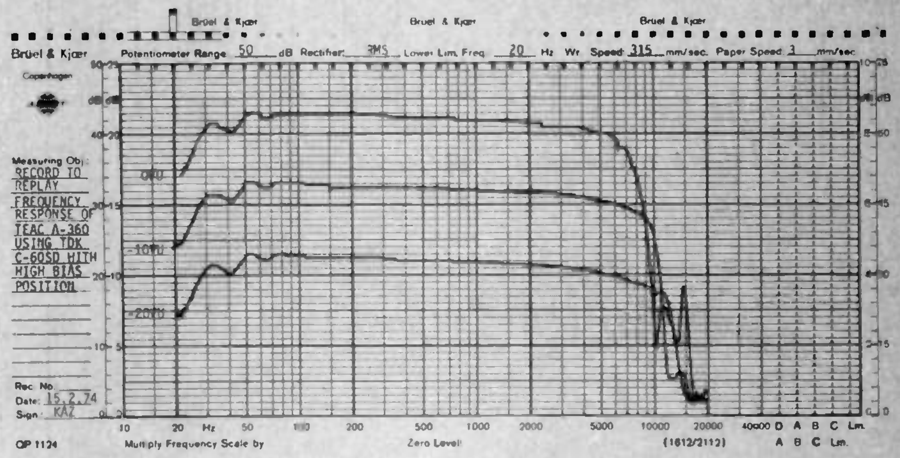
The internal construction is particularly interesting. A number of unusual features are apparent. The first of these is a very large capstan wheel the diameter of which is approximately 9 cms. Secondly, there is a large external rotor motor, which in conjunction with the large capstan wheel results very low wow and flutter figures. The third is the use of very large quantities of miniature shielded wire. These are formed into large wiring harnesses.

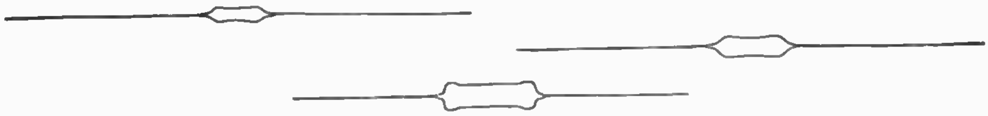
The machine contains three printed circuits. These are respectively, the











TEAC A·360 CASSETTE RECORDER

power supply card, the large main amplifier card, and the Dolby B processor card.

The main amplifier card and the Dolby B processor card are held on one edge by a plastic support system which after the removal of the screws on the other side, allows the cards to be hinged back for servicing and component replacement. The large wiring harnesses which we previously mentioned, are jammed against one side of the Dolby B processor card and cause component displacement. Fortunately these components have plastic coating on their pigtails which prevents electrical shorts.

Another interesting feature which will interest the technically minded is the use of a C-core mains transformer.

The circuit designers, in keeping with the latest European and Japanese trends, have saved some wiring by locating two of the main switches on the main amplifier card with mechanical actuation from the front panel.

A well produced twenty-two page handbook is supplied with the machine. It was good to see that this handbook contained a full circuit diagram of the machine.

As with the Teac A-350, the performance of the A-360 is particularly good. Its major advantages are primarily operational rather than any significant improvement in frequency response or wow and flutter.

Nevertheless, there *have* been positive improvements in the circuitry of the A-360, and definite improvements in the mechanical drive system which is clearly better than that provided in the A-350.

MEASURED PERFORMANCE

The frequency response at −10 VU is 27 Hz to 13 kHz with chromium oxide. At −20 VU it is 28 Hz to 16 kHz. This is one order of performance better than that provided by the A-350 and it should be noted that the overall linearity of the frequency response is better at the high frequency end of the spectrum and substantially flatter at the low frequency end as well.

With TDK Super Dynamic tape, performance at −10 VU is 28 Hz to 8 kHz, and at −20 VU it is 28 Hz to 10 kHz. We found that the record-to-replay performance was better with the bias and equaliser set to normal rather than in the high position. From a comparison with the performance on standard and super dynamic tapes chromium dioxide tape may well be a must with these machines. It certainly was with the machine supplied to us for review.

Total harmonic distortion is reasonable, being 1% at 1 kHz at 0 VU, and 0.6% at 1 kHz at −10 VU.

Intermodulation distortion is also acceptable, at 0.8% at 0 VU, and 0.5% at −10 VU.

Wow and flutter is not quite as good as the manufacturer's claim, being 0.1% at the beginning of a cassette and 0.05% in the middle.

Signal-to-noise ratio (at 1 kHz) is −55 dB(A) with Dolby on, and −47 dB(A) without the Dolby.

Erase ratio is very good, being −63 dB.

Cross talk between channels is −45 dB at 100 Hz and −50 dB at 1 kHz.

Overall performance of the A-360 is good, it is marginally better than the A-350 that we tested two years ago. There are also some clear operational improvements.

Teac's A-360 is a good machine and should satisfy most hi-fi enthusiasts' requirements.

NOTE

The machine described here was the second of two units submitted to us for review.

The first machine was found to have an incorrectly aligned tape guidance system. This affected performance adversely.

Although the quite serious fault had obviously been overlooked by TEAC's final-inspection department, our past experience with TEAC equipment indicates that faults of this nature are uncommon.

TEAC A-360 CASSETTE RECORDER
SERIAL NO: 29410

Record to Replay Frequency Response:				1 7/8 ips
(with BASF CrO2 tape) at:	0 VU	30 Hz– 9 kHz		±3 dB
	−10 VU	28 Hz–13 kHz		±3 dB
	−20 VU	28 Hz–16 kHz		±3 dB
(with TDK C60 tape) at:	0 VU	28 Hz–5.5 kHz		±3 dB
	−10 VU	28 Hz– 8 kHz		±3 dB
	−20 VU	28 Hz– 10 kHz		±3 dB
Total Harmonic Distortion at 1 kHz at:		100 Hz	1 kHz	6.3 kHz
	0 VU	1.2%	1%	1%
	−10 VU	0.5%	0.6%	0.8%
Intermodulation Distortion (at 1 kHz and 960 Hz):	0 VU	0.8%		
	−10 VU	0.5%		
Signal to Noise Ratio (at 0 VU re 1 kHz):	with Dolby		without Dolby	
	−38 dB (Lin)		− 37 dB (Lin)	
	−55 dB (A)		−47 dB (A)	
Erase Ratio (for 1 kHz signal prerecorded at 0 VU):				−63 dB
Cross Talk at 0 VU:	100 Hz		− 45 dB	
	1 kHz		− 50 dB	
Wow & Flutter % – weighted		0.1% at beginning		
		0.05% in middle		
Line Input Sensitivity for 0 VU:				90 mV
Microphone Input Sensitivity for 0 VU:				0.25 mV
Line Output Sensitivity for 0 VU:				0.45 mV
Dimensions	438 x 254 x 124 mm			
Weight	8 kg			

Photograph of Marconi taken in London in 1896, showing the original apparatus brought by him from Italy.

A TRIBUTE TO MARCONI

Centenary year of birth of Guglielmo Marconi, the father of 'wireless'.

ONE HUNDRED years ago, (April 25th, 1874) Guglielmo Marconi was born in Bologna, the younger son of a wealthy Italian landowner, Giuseppe Marconi, and his Irish wife Annie, the daughter of Andrew Jameson, a whiskey distiller from County Wexford in Ireland.

To Guglielmo Marconi must go the credit for seeing the wider possibilities of wireless. Of taking it out of the laboratory where pure science had shackled it, and developing practical systems for the benefit of mankind. His work, and that of the brilliant men with whom he surrounded himself in the company he formed, laid the foundations of the electronics industry as we know it today.

Marconi was interested in science from an early age. By his late teens he was experimenting with electro-magnetic waves as a communication medium. By the summer of 1895 he had succeeded in transmitting signals over a few yards of space, and in August, using an earth and an elevated aerial at both transmitter and receiver, he was able to transmit Morse Code over 1¾ miles.

The Italian Government was not greatly interested in Marconi's invention, so in 1896 he came to England where he filed the world's first patent for a system of telegraphy using Hertzian waves. A letter of introduction to William Preece, Engineer in Chief of the GPO, led to a series of demonstrations culminating in 1897 in a record transmission across 8.7 miles of the Bristol Channel, where Preece himself was experimenting with inductive methods, but with far less success.

The potential of wireless telegraphy was becoming clear and in 1897 the world's first radio company was formed to develop Marconi's apparatus commercially. First called the Wireless Telegraph and Signal Company, it was later renamed Marconi's Wireless Telegraph Company and in 1963, The Marconi Company.

By the end of the century, wireless had been adopted by the British and the Italian Navies, it had spanned the English Channel, it had proved its worth to the mercantile navy as a life saver and Marconi had introduced his system to the USA, where he registered The Marconi Wireless Telegraph Company of America — later to become the Radio Corporation of America (RCA).

One of Marconi's ambitions had been to use wireless as a means of ending the isolation of those at sea, and in 1900 the Marconi International Marine Communication Company was created to work an exclusive licence for all maritime purposes. At this time also he took out his famous Four Sevens patent for tuned coupled circuits.

In 1901, the world's first wireless school opened at Frinton, later transferring to Chelmsford where it still flourishes.

This was a vintage year of Marconi. Having achieved communication over 198 miles between the Isle of Wight and the Lizard, he embarked, with the assistance of Dr J.A. Fleming (Scientific Adviser to the Company), R.N. Vyvyan, G. Kemp and P.W. Paget, on his famous transatlantic experiment. After many vicissitudes he succeeded in receiving, through an earpiece, signals at St John's, Newfoundland, transmitted from Poldhu, Cornwall. Even at the moment of this, his greatest triumph, some said that he mistook atmospherics for the Morse code "S". To those doubters it has been pointed out that for long distance communication to have evolved from the system that pushed three faint dots across 2000 miles is a marvel; had there been no dots, its evolution has been a miracle. Two months later, signals from Poldhu were recorded on a morse inker on s.s. 'Philadelphia' — 2099 miles away — thus dispelling any doubt about his original claim. In December 1902, Poldhu's permanent opposite number was built at Glace Bay.

During the next few years, many important patents were filed, notably those for the magnetic detector, the radio valve developed by Dr Fleming, and the directional aerial, which was used at Clifden, in Ireland — a station that took over the transatlantic service from Poldhu. In 1909, Marconi shared a Nobel Prize for Physics in recognition of his contribution to wireless telegraphy.

The decade that preceded the First World War also saw the first use of wireless in the air, transmission initially being achieved from a captive balloon and then, in 1910, from an aeroplane flown by J.D.A. McCurdy. It also saw wireless used to assist the capture of the notorious murderer, Dr Crippen, and to save lives when the ill-fated 'Titanic' foundered.

When war broke out in 1914, the Admiralty at once took over the Marconi radio factory. This, the first in the world, had transferred in 1912 from Hall Street, Chelmsford, to a new, purpose-designed building a mile or so away. The Clifden station and Marconi's operational equipment in Chelmsford and London were also taken over, along with the first long-wave transatlantic wireless station for direct communication with the USA, completed by Marconi during 1914.

The company, having developed

direction-finding techniques before the war, established a chain of stations that were used to devastating effect against enemy Zeppelins, submarines and surface ships, and led, indeed, to the Battle of Jutland. For the Royal Navy's world-wide communications network, the company built a dozen widely dispersed stations.

Air-to-ground telegraphy was perfected and the difficulties of ground-to-air telephony were overcome by three Marconi engineers, Major C.E. Prince, Capt. H.J. Round and Lt. J.M. Furnival – the last named also supervising the achievement of inter-aircraft telephony in 1917.

Marconi himself was commissioned in the Italian Army. He later became deeply involved in diplomatic work for Italy, and, after the war, was appointed Plenipotentiary Delegate to the Paris Peace Conference.

In 1919, Marconi bought his yacht, 'Elettra', which he equipped as a laboratory; a Marconi engineer made the first east to west transatlantic telephony transmission; and the embryo of broadcasting took shape in Chelmsford.

In 1920, at Marconi's Works, Nellie Melba gave a song recital for Britain's first advertised public broadcast. Twenty months later the company was licensed for regular broadcasting and erected the famous 2MT station in an ex-army hut at its Writtle Laboratories. A licence was also granted for the 2LO station in Marconi House, London. Later in 1922, at the instigation of the PMG, Marconi's and five other manufacturers formed the British Broadcasting Company, superseded in 1926 by the British Broadcasting Corporation.

The Marconiphone Company, formed in 1922 to satisfy the demand for domestic receivers, was sold to RCA in 1929 and later merged with two other companies to become EMI, of which Marconi was President.

Meanwhile, the company supplied the equipment for the BBC's new longwave station at Daventry, which took over the 5XX call sign of an earlier station built at Chelmsford.

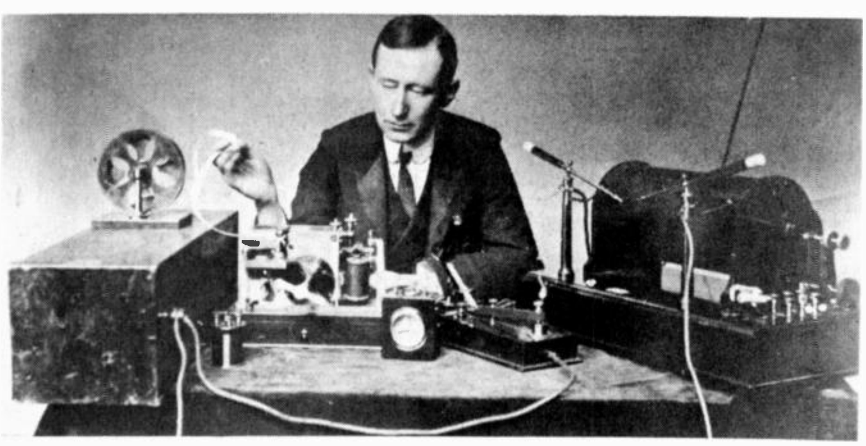
Running parallel with the company's broadcasting activity was Marconi's involvement with the Government's plan to link Britain through a wireless communication network. First mooted in 1906, the Imperial Wireless chain contract was awarded to Marconi in 1924, exactly fifty years ago. The first station was opened in 1926 and, in common with all those that followed, used the Marconi-Flanklin Beam System – a newly developed, revolutionary form of shortwave directional transmission. The Company too built its own beam stations for communicating with countries outside Britain.

The success of the Imperial Wireless Chain so threatened the British cable companies that, in 1929, at the instigation of the respective governments, their interests were merged with those of the Marconi Company in a new organization, Cable and Wireless Limited.

This step shattered Marconi's life-long ambition to control an Empire-wide wireless network. Disappointed and in ill-health, he was increasingly drawn to his home in Italy, from which he conducted microwave experiments, installing the first microwave telephone link in 1932, and in 1935 demonstrating principles of radar.

Meanwhile his company in England was advancing the new medium of television, its interests in which it merged with those of EMI to form the Marconi-EMI Television Company Limited (later dissolved) whose system was adopted in 1936 by the BBC for the world's first public high definition television service.

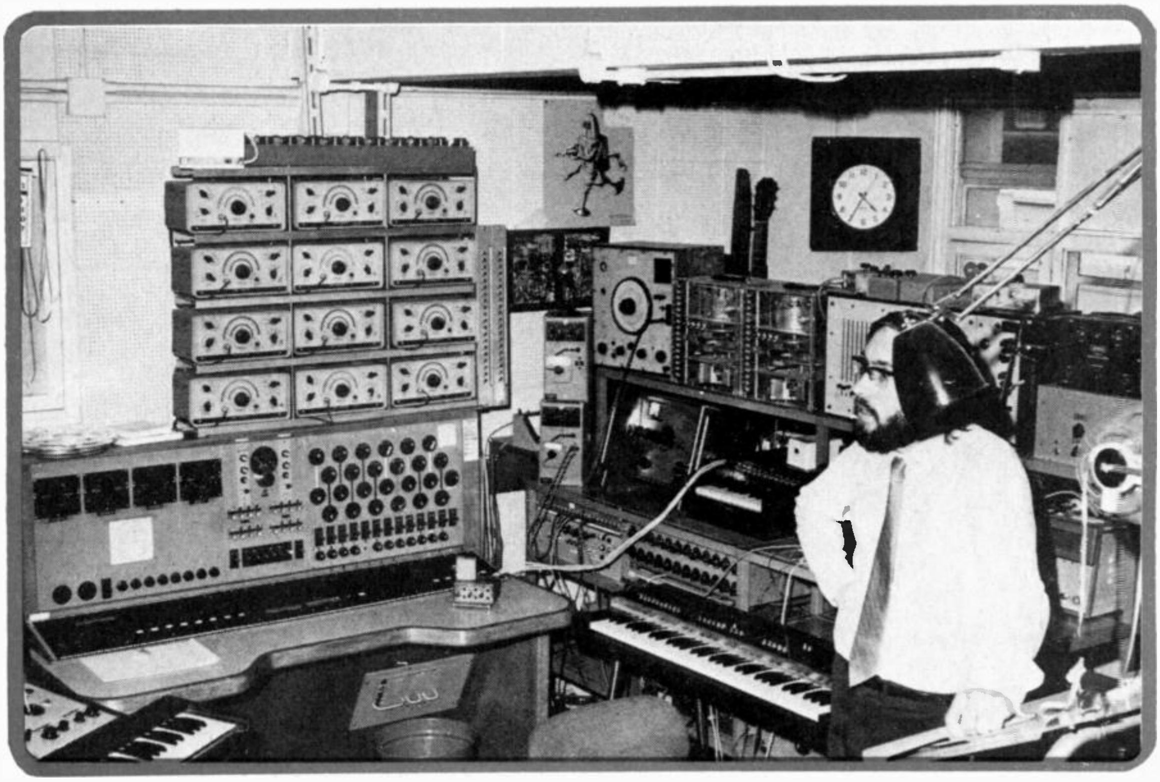
In Italy, Marconi's health was deteriorating rapidly. He was taken ill on 19th July 1937 and died the following day. Of all the tributes that followed, the most impressive, the gesture that was unique, was the closing down for two minutes of wireless stations throughout the world. The 'ether' was as quiet as it had been before Marconi. ●



Marconi with the equipment used in the first Transatlantic transmission across the Atlantic in 1901.

RADIOPHONIC WORKSHOP

Electronic technology evolves its own art forms.



(TOP): Synthi 100 Electronic Music Synthesiser
(ABOVE): General view of one of the Workshop areas showing bank of tuned oscillators.

A CONVERTED skating rink in the heart of London's Maida Vale is the home of the highly specialized B.B.C. department, picturesquely known as the Radiophonic Workshop. Responsible for virtually all the incidental electronic music and effects for BBC radio and television, it is unique in that all of its output is commissioned. Furthermore, this output is the product of a small but dedicated staff of musicians/technicians — the Workshop is not generally open to outside composers nor for the production of electronic music as an end in itself.

The BBC has, however, issued two collections, selected from the Workshop's sizeable output, that offer a fascinating insight into the extent to which electronic technology has evolved its own art forms.

The two discs highlight different modes of working, with some common ground in the manner in which the final tracks have been realized i.e. by the synchronized playing of a number of separate musical tracks.

The individual tracks were physically separate in the case of the LP *"BBC Radiophonic Music" (REC 25M)* — each completed musical part was laced up on a separate Philips EL3566 console tape machine and the final mix conducted by replaying the synchronized tapes and recording the result on a further machine. The playing of machines 'wild' in theory should not work, but in practice, synchronization between tracks is maintained for periods greater than a minute.

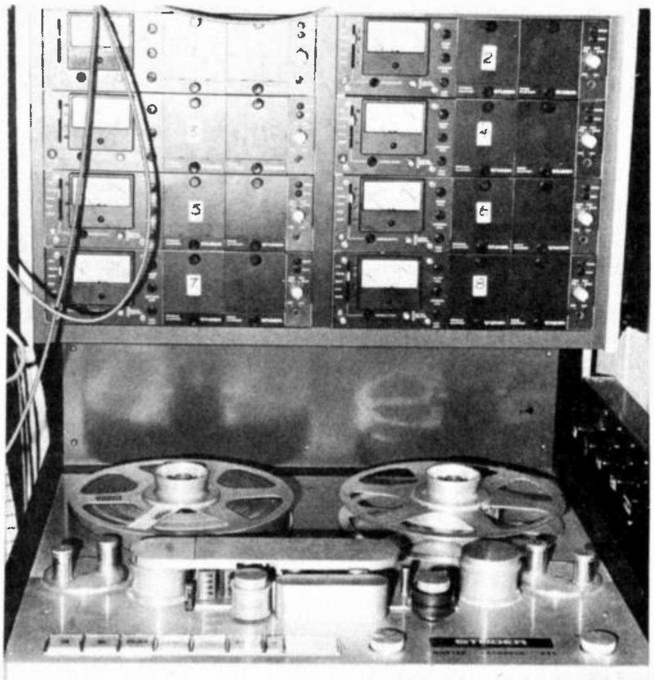
The tracks on the *"Fourth Dimension" LP (RED 93S)* were produced on rather more recognized studio principles with the aid of an eight-track Studer A60 recorder.

"Radiophonic Music", the earlier disc, was only pressed in mono, but notwithstanding, makes highly entertaining listening from the technical aspect alone.

At least three days concentrated effort go into a twenty *second* piece to produce a final result. After the composition on paper, styled to the wishes of the programme producer who has commissioned it, the worker will explore all possible sounds suitable for the piece. A dripping tap, two bricks knocked together, or a cork pulled out of a bottle, any of these may fit the bill.

The various sounds are recorded and after more careful listening and experimenting, a final selection is made.

Provisionally, three well-contrasting sounds may be selected; loops of tape with the selected sounds are played continuously on a special recorder with incremental speed change facility.



Studer A60 8 track tape recorder.

There are a number of switched steps between one standard tape speed and the next and, as reproduced pitch is relative to the reproducing tape speed, a scale of notes can be derived from a single sound. The scale is recorded on another machine, possibly using filters to change the character of the notes and different recording volumes to give the required dynamic range.

After this comes the exacting task of piecing together all the notes of one 'instrument' in the right order and taking care to space the notes by appropriate silent gaps to give correct tempo.

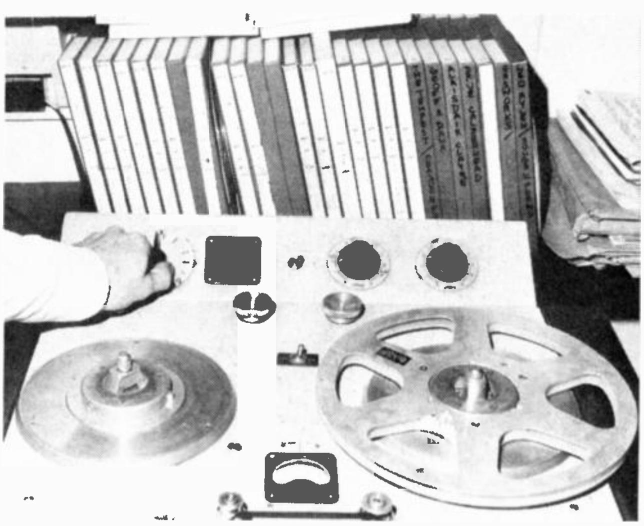
When the separate musical parts have been compiled, the final mix is carried out as already detailed.

At any stage in the process further tonal modification, reverberation, envelope shaping or a host of other techniques may be applied to give a 'different' sound.

The music? 'Different' is one, if inadequate, way to describe it. Using natural sounds (though pure electronic tones are used when considered desirable) in this fastidious manner, unique and quite beautiful results are achieved.

All the tunes sound 'fresh' and it is possible to identify each composers individual style. The majority of John Baker's work has a lively almost pointillistic arrangement of melody, counter melody and bass line, each complementing the other. He tends to utilise well-contrasting timbres, offsetting harsh percussive notes with more rounded notes with slow attacks.

My personal favourite is "Sea Sports" which features an ethereal watery reverberation, quite different



Variable speed Leevers Rich used to give a chromatic scale from a single note or sound.

RADIOPHONIC WORKSHOP

from any effect I have heard before.

To find out more about the basic sounds he used, I contacted John Baker; the sound sources he said, included twanged rulers, bubbles escaping, plucked undamped piano strings, metal springs being released and corks popping from bottles.

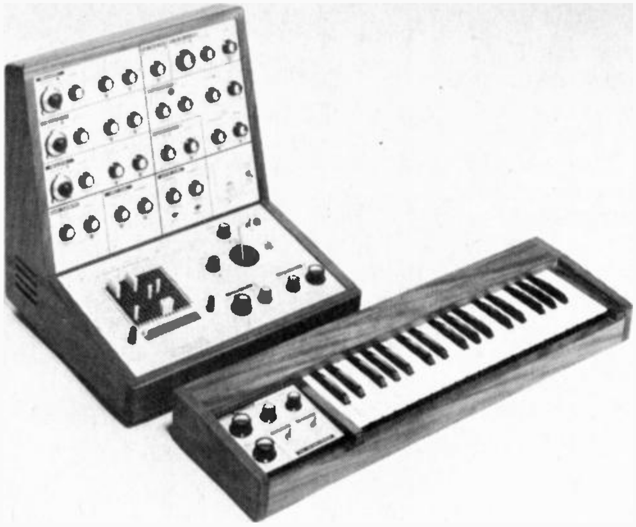
The second composer on this record, Delia Derbyshire, incidentally now no longer with the Workshop, has a rather different approach, preferring to synthesize complex sounds from electronic tones.

I found her offerings on this disc highly evocative, especially her "Blue Veils and Golden Sands" — it was very noticeable how tonal qualities and contrasts have almost a greater role in her compositions than even the melody does, although her "Door to Door", with its collection of 'musical door-knockers' shows her versatility with its infectious foot-tapping lilt.

David Cain is the final composer on this disc. Originally qualifying in mathematics, he joined the BBC as a studio manager on the drama side. His works here span a wide spectrum of styles, ranging from Baker's effervescence to a "classical" Stockhausen-like approach. It is music for the radio production "War of the Worlds" was most thought-provoking.

The second record features Paddy Kingsland's synthesizer work at the Workshop. This stereo disc contains twelve tracks composed and produced by Kingsland for various radio and TV programmes.

A different style is once again very evident — on most tracks he uses a basic backing of conventional instruments, drums and guitars with the melody, and one or more harmonies produced on voltage controlled electronic music synthesizers — these being the British EMS Synthi 100 and its diminutive, though nevertheless extremely versatile, brother, the VCS3.



VCS3 Electronic Music Synthesiser.

The Synthi 100, in addition to numerous sine, square and sawtooth generators, noise sources, ring modulators, envelope amplifiers, filters and other signal modifying devices, contains a three parameter 256 event digital memory. Programmed by a conventional keyboard, the recorded information can be 'edited' as required and the sequence run at any speed in either direction.

I was rather sorry that Kingsland placed so much emphasis on acoustic instrumental backing in view of the capabilities of the apparatus at his disposal, but this no doubt must be partly attributed to the wishes of those who provide the Workshop with its commissions.

"Colour Radio" on the second side has some attractive quasi-vocalisations but, of this selection "Flashback" and the title track held my interest most.

In summary, Kingsland reveals himself to be a competent and adept composer and I hope he is given more rein to experiment with the Synthi. It would be an education to hear his work integrated with an 'edited-tape' backing, as featured on the examples on the earlier disc, instead of the 'straight' backings he has used here. ●

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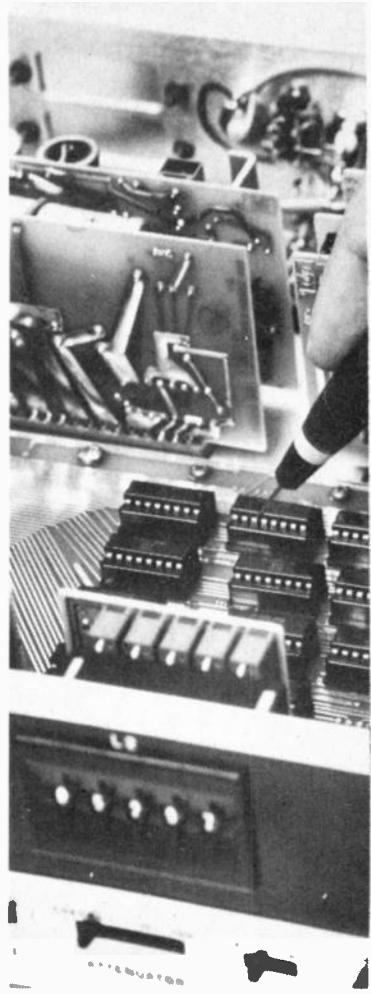
TECHNIQUES OF DIGITAL FAULT-FINDING



Digital circuitry is being used more and more. Its benefits are enormous, but they are accompanied by major problems in servicing and repair.
Totally new techniques and servicing equipment are required.

DIGITAL integrated circuits have revolutionized the electronics industry. Areas such as pocket calculators, digital computers, and all phases of a heretofore analogue world are exploding with more complex, compact, and powerful products than ever before. But this advance in electronics has not come without a price. The digital integrated circuit has also brought a major headache in maintaining and repairing these products. Fundamental differences between analogue and digital circuits and the resulting need for new instrumentation and troubleshooting techniques are responsible for these problems.

1. ANALOGUE TECHNIQUES AND DIGITAL TROUBLESHOOTING

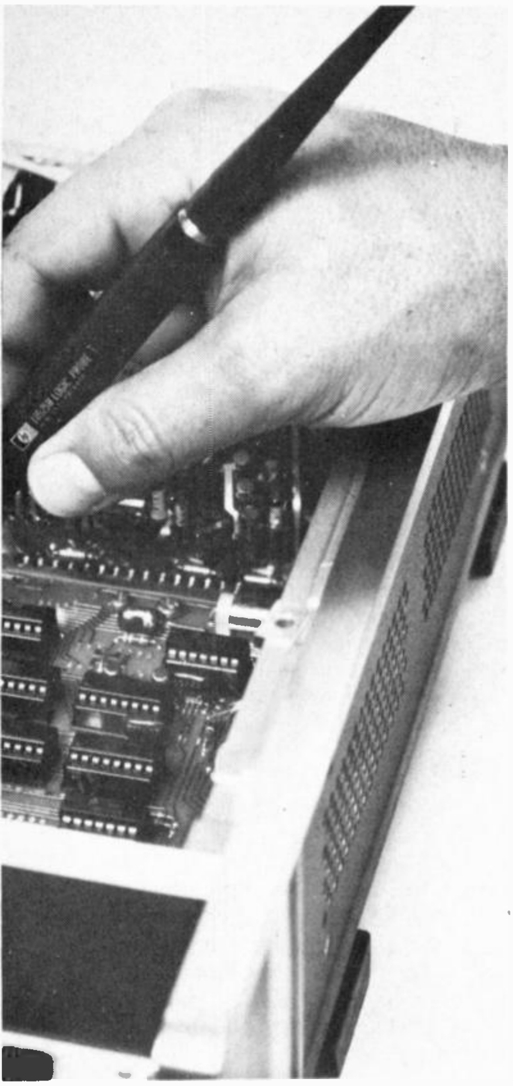
When fault-finding circuits built from discrete components, the task is one of verifying relatively simple characteristics such as resistance, capacitance, or turn-on voltages of components with two or at most three nodes. And while the function of the total circuit may be quite complex, each component in that circuit performs a relatively simple task and proper operation is easily verified.

In Figure 1, each diode, resistor, capacitor and transistor can be tested using a signal generator and a voltmeter, ohmmeter, diode checker, or oscilloscope — the traditional servicing tools. But when this circuit is built in integrated circuit form, these components are no longer accessible. It now becomes necessary to test the operation of the complete circuit function.

Thus an important difference between discrete circuitry and today's circuits built from digital IC's is in the complexity of the functions performed by these new "components". Unlike the resistor, capacitor, diode or transistor, which must be interconnected to form a circuit function, today's digital IC performs complete, complex functions. Instead of observing simple characteristics, it is now necessary to observe complex digital signals and decide if these signals are correct according to the function the IC is meant to perform.

Verifying proper component operation now requires stimulating and observing many inputs (in Fig. 1 there are 10 inputs) while simultaneously observing several outputs (often two or three and at times as many as eight). Thus another fundamental difference between circuitry built from discrete components and digital IC's is the number of inputs and outputs associated with each component, and the need to stimulate and observe these simultaneously.

In addition to the problems of simultaneity of signals and complexity of functions at the component level, the digital IC has introduced a new degree of complexity at the circuit level. Circuits which perplex all but their designer are commonplace. Given enough time, these circuits can be studied and their operation understood, but this is not an affordable luxury for those involved in troubleshooting electronic circuits. Without understanding a circuit's intricate operation, it becomes necessary to have a technique of quickly testing each component rather than attempting to isolate a failure to

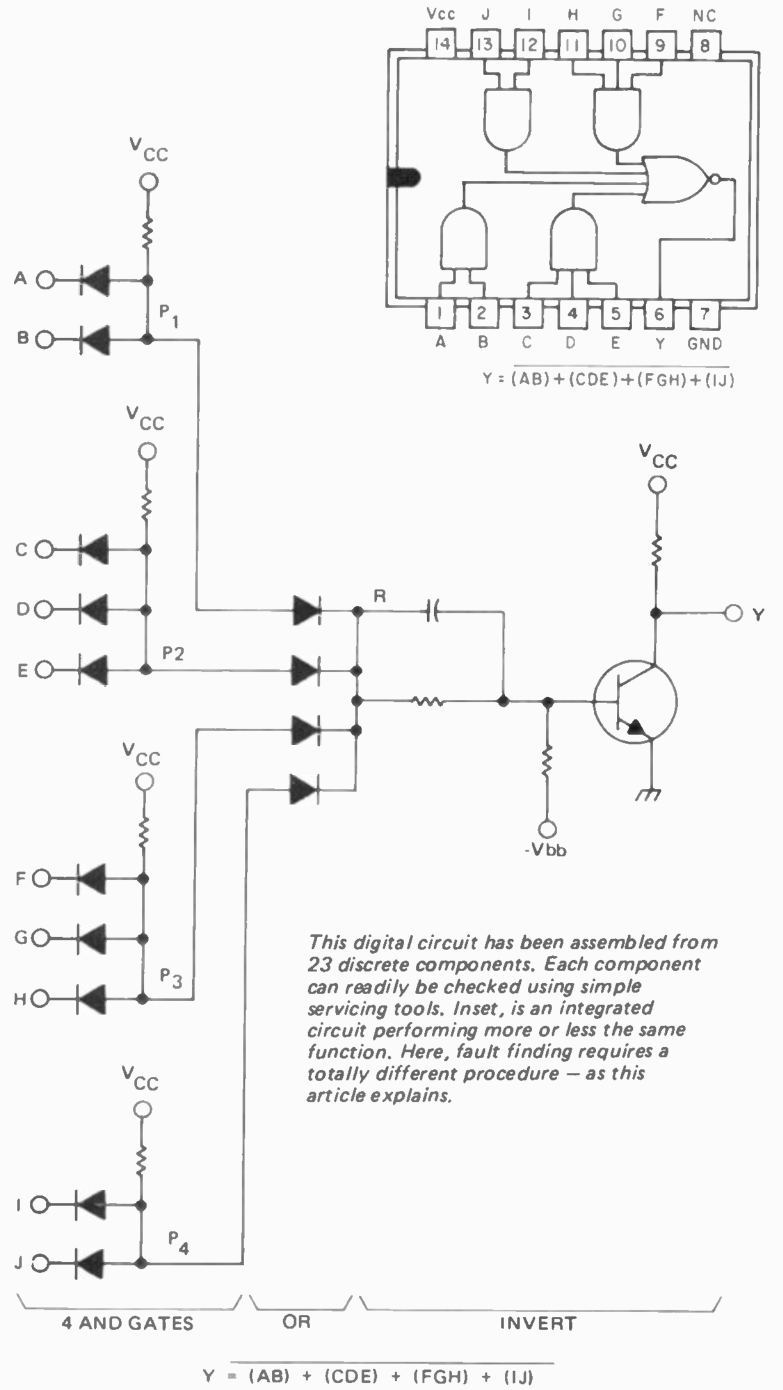


a particular circuit segment by testing for expected signals.

In order to solve these problems and to make fault-finding of digital circuits more efficient, it is necessary to take advantage of the digital nature of the signals involved. Tools and techniques designed to service analogue circuits do not take advantage of this digital nature and thus are less efficient when used to troubleshoot digital circuits.

Figure 2 shows a typical TTL (Transistor-Transistor-Logic) signal. This might as well be any analogue signal when viewed on an oscilloscope. The oscilloscope displays absolute voltage with respect to time, but in the digital world absolute values are unimportant.

A digital signal exists in one of two or three states — high, low, and undefined or in-between level — each determined by a threshold voltage. It is the relative value of the signal voltage with respect to these thresholds that determines the state of the digital signal and this digital state determines the operation of the IC, not absolute levels. In Figure 2, if the



This digital circuit has been assembled from 23 discrete components. Each component can readily be checked using simple servicing tools. Inset, is an integrated circuit performing more or less the same function. Here, fault finding requires a totally different procedure — as this article explains.

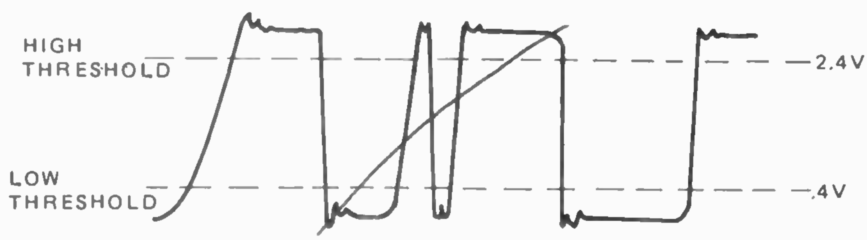


Fig.2. TTL signal. In the digital world, the relative value of a signal voltage with respect to the threshold voltages determines the operation of the circuit. A signal above the high threshold is in the high state and whether it is 2.8 V or 3.0 V is unimportant to the operation of the circuit.

TECHNIQUES OF DIGITAL FAULT-FINDING

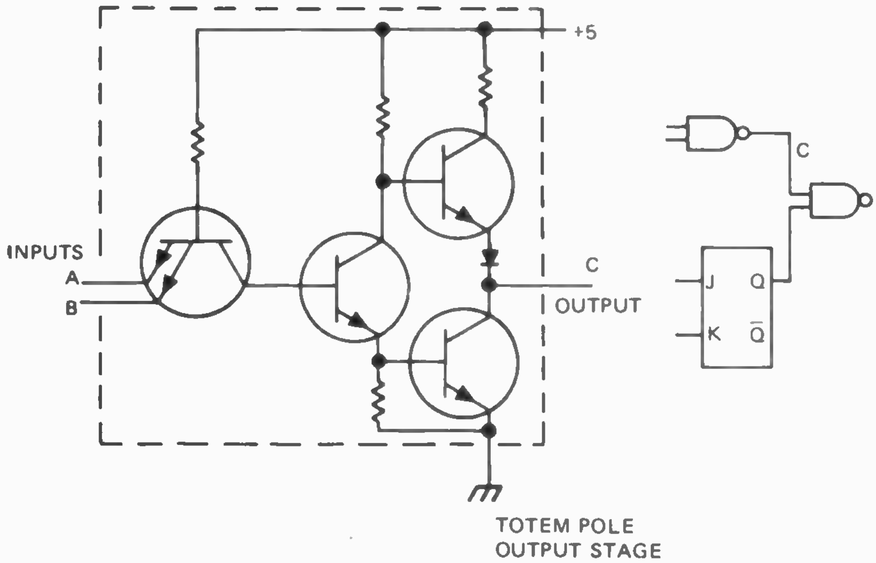


Fig.3. When stimulating a node in a circuit, such as C above, it is necessary to over-ride the low impedance 'totem pole' output stage driving that node. When the output is in the low state, it is a saturated transistor to ground. Most signal sources available today are not powerful enough to over-ride this low state.

signal is greater than 2.4 volts, it is a high state and it is unimportant whether the level is 2.8 or 3.0 volts. Similarly for a low state the voltage must be below 0.4 volts. It is not important what the absolute level *is* as long as it is below this threshold. Thus when using an oscilloscope, the serviceman must over and over again determine if the signal meets the threshold requirement for the desired digital state.

Within a digital logic family, such as TTL, the timing characteristics of each component are well defined. Each gate in the TTL logic family displays a characteristic propagation delay time, rise time, and fall time. The effects of these timing parameters on circuit operation are taken into account by the designer. Once a design has been developed beyond breadboard or prototype stage and is into production, problems due to design have (hopefully) been corrected.

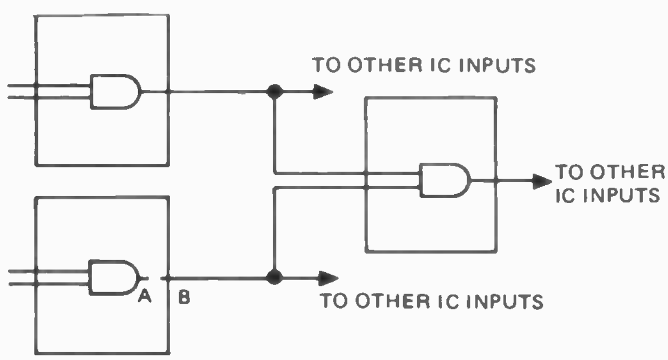
An important characteristic of digital IC's is that when they fail, they fail catastrophically. This means that timing parameters rarely degrade or become marginal. Thus observing on an oscilloscope and making repeated decisions on the validity of timing parameters is time consuming and contributes very little to the fault-finding process. Once problems due to design are corrected, the fact that pulse activity *exists* is usually enough indication of proper IC operation without further observation of pulse width, repetition rate, rise time or fall time.

Figure 3 shows a problem created by the TTL logic family. The output stage of a TTL device is a transistor totem pole. In either the high or low state, it is a low impedance. In the low state it is a saturated transistor to ground. It thus appears as 5-10 ohms to ground. This presents a problem to in-circuit stimulation. A signal source used to inject a pulse at a node which is driven by a TTL output must have sufficient power to override the low impedance output state. Most sources presently used for fault-finding do not provide this capability. It has been necessary for the serviceman to either cut printed circuit traces or pull out IC leads in order to stimulate the circuit being tested. Both of these practices are time consuming and lead to unreliable repairs.

Thus the use of the traditional oscilloscope and the traditional signal sources is inefficient. Since the diodes and transistors are packaged in the IC, use of diode checkers is also marginal. These tools are general purpose tools that can be applied to any situation if the serviceman has enough time. But with the quantity and complexity of today's electronic circuits, it makes sense to find the most efficient solution to the problem at hand. This suggests using the oscilloscope, diode checkers and voltmeter on analogue circuits where they really shine, and using instruments that take advantage of the digital nature of signals on the digital circuitry to be repaired.

In order to repair digital equipment efficiently, it is important to understand the type of failures found in digital circuits. These can be categorized into two main classes — those caused by a failure *internal* to an IC and those caused by a failure in the circuit *external* to the IC.

Four types of failures can occur internally to an IC. These are (1) an open bond on either an input or output, (2) a short between an input



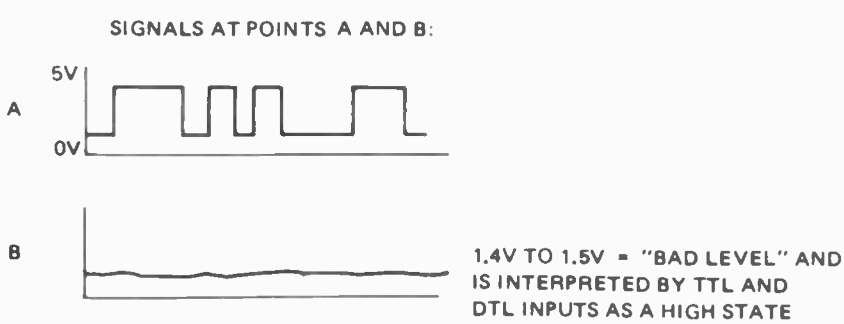


Fig.4. The effect of an open output bond upon circuit operation. An open output bond allows all inputs driven by that output to float to a "bad level". This level is usually interpreted as a logic high state by the inputs. Thus the inputs driven by an open output bond will respond as though a static logic high signal was applied.

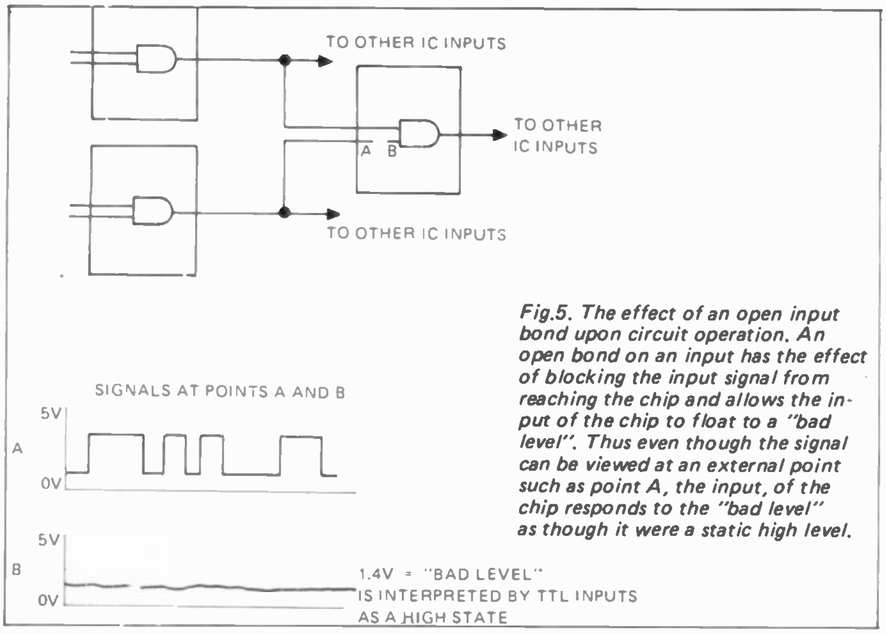


Fig.5. The effect of an open input bond upon circuit operation. An open bond on an input has the effect of blocking the input signal from reaching the chip and allows the input of the chip to float to a "bad level". Thus even though the signal can be viewed at an external point such as point A, the input, of the chip responds to the "bad level" as though it were a static high level.

or output and Vcc or ground, (3) a short between two pins (neither of which are Vcc or ground), and (4) a failure in the internal circuitry (often called the steering circuitry) of the IC.

In addition to these four failures internal to an IC, there are four failures that can occur in the circuit external to the IC. These are (1) a short between a node and Vcc or ground, (2) a short between two nodes (neither of which are Vcc or ground), (3) an open signal path, and (4) a failure of an analogue component.

Before showing how to detect each of these failures we will discuss the effect each has upon circuit operation. The first failure (internal to an IC) mentioned, was an open bond on either an input or output. The failure has a different effect depending upon whether it is an open output bond or an open input bond. In the case of an open output bond (Fig. 4), the inputs driven by that output are left to float. In TTL and DTL circuits a floating input rises to approximately 1.4 to 1.5 volts and usually has the same effect on circuit operation as a high logic level. Thus an open output bond will cause all inputs driven by that output to float to a bad level since 1.5 volts is less than the high threshold level of 2.0 volts and greater than the low threshold level of 0.4 volt. In TTL and DTL, a floating input is interpreted as a high level. Thus the effect will be that these inputs will respond to this bad level as though it were a static high signal.

In the case of an open input bond (Fig. 5), we find that the open circuit blocks the signal driving the input from entering the IC chip. The input on the chip is thus allowed to float and will respond as though it were a static high signal. It is important to realize that since the open circuit occurs on the input inside the IC, the digital signal driving this input will be unaffected by the open circuit and will be detectable when looking at the input pin (such as at Point A in Fig. 5). The effect will be to block this signal inside the IC and the resulting IC operation will be as though the input were a static high.

A short between an input or output and Vcc or ground has the effect of holding all signal lines connected to that input or output either high (in the case of a short to Vcc) or low (if shorted to ground) (Fig. 6). In many cases, this will cause expected signal activity at points beyond the short to disappear and thus this type of failure is catastrophic in terms of circuit operation.

A short between two pins is not as straightforward to analyze as the short to Vcc or ground. When two pins are shorted, the outputs driving those pins oppose each other when one attempts to pull the pins high while the other attempts to pull them low (Fig. 7). In this situation the output attempting to go high will supply current through the upper saturated transistor of its totem pole output stage, while the output attempting to go low will sink this current through the lower saturated transistor of its totem pole output stage. The net effect is that the short will be pulled to a low state by the saturated transistor to ground. Whenever both outputs attempt to go

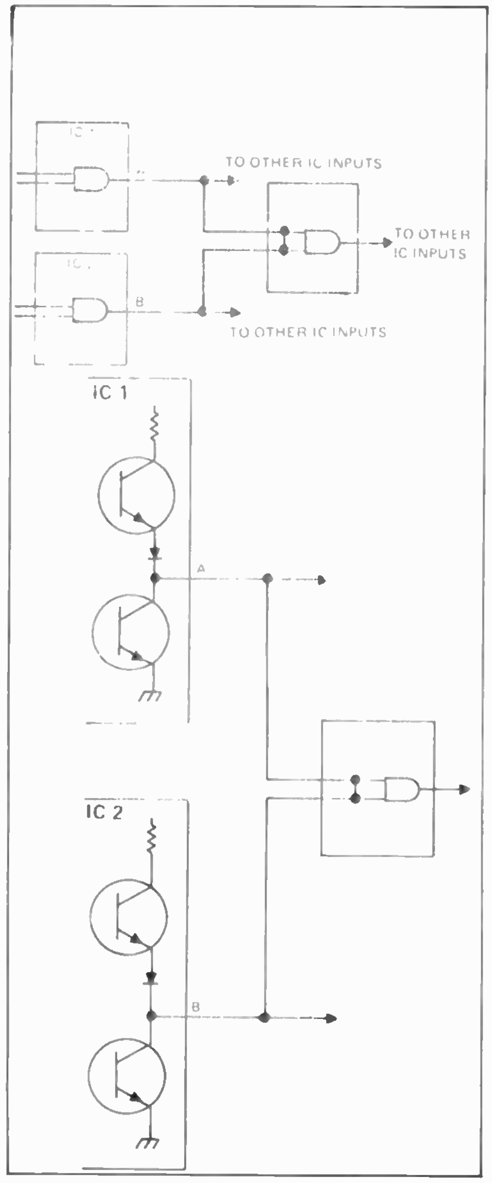


Fig.7. The error effect of a short between two pins occurs when the outputs driving those pins attempt to pull the short to opposite states. In this case, the output attempting to pull the node high will be supplying current while the output attempting to pull the node low is a saturated transistor to ground and will be sinking the current. The saturated transistor to ground will thus pull the node to a low state.

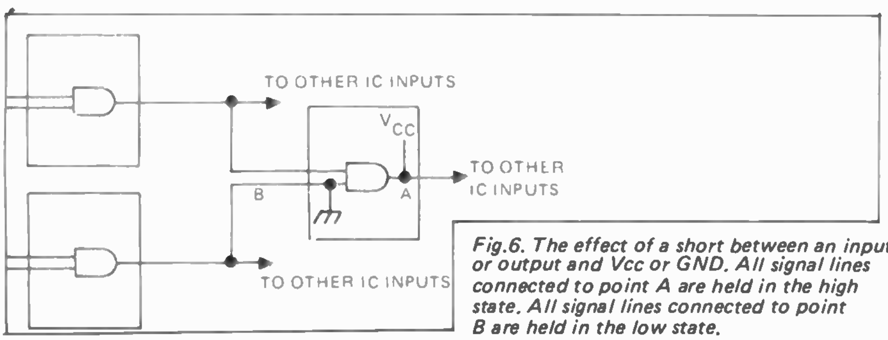


Fig.6. The effect of a short between an input or output and Vcc or GND. All signal lines connected to point A are held in the high state. All signal lines connected to point B are held in the low state.

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high simultaneously, or to go low simultaneously, the shorted pins will respond properly. But whenever one output attempts to go low the short will be constrained to be low.

The fourth failure internal to an IC is a failure of the internal (steering circuitry of the IC (Fig. 8). This has the effect of permanently turning on either the upper transistor of the output totem pole, thus locking the output in the high state, or turning on the lower transistor of the totem pole thus locking the output in the low state. Thus this failure blocks the signal flow and has a catastrophic effect upon circuit operation.

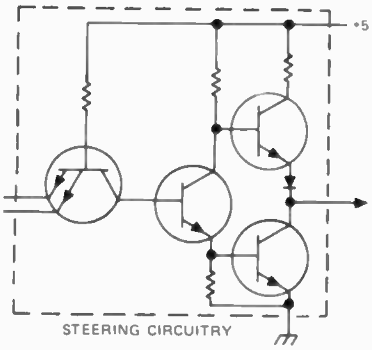

Fig.8. The effect of a failure of the internal circuitry of the IC upon circuit operation. A failure of the steering circuitry of an IC will either cause the output to be in a static high state or a static low state.

A short between a node and Vcc or ground external to the IC is indistinguishable from a short internal to the IC. Both will cause the signal lines connected to the node to be either always high (for shorts to Vcc) or always low (for shorts to ground). When this type of failure is encountered only a very close physical examination of the circuit will reveal if the failure is external to the IC.

An open signal path in the circuit has a similar effect as an open output bond driving the node (Fig. 9). All inputs to the right of the open will be allowed to float to a bad level and will thus appear as a static high level in circuit operation. Those inputs to the left of the open will be unaffected by the open and will thus respond as expected.

The 1 μF capacitor is necessary to ensure circuit stability. However, it limits the rate at which the voltage across the load can change in response to a sudden change in load resistance. This response time can be found by multiplying the capacitor value by the final load resistance. The instantaneous load current is found by dividing the instantaneous output voltage by the final value of load resistance.

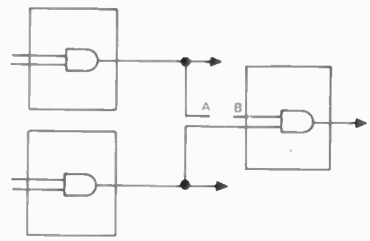

Fig.9. The effect of an open in the circuit external to an IC. All inputs attached to the node at point A will be driven properly. All inputs to the right of the open (point B) will be left to float to a "bad level" and will therefore look like a static high state.

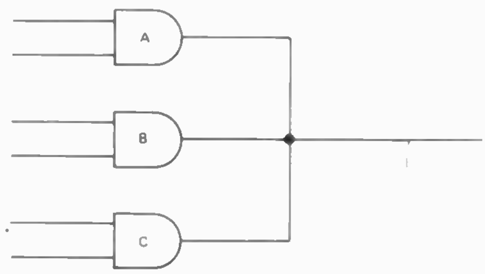

Fig.10. The "open collector" problem. When gates are connected in the "wired-OR" arrangement, the output of one IC can constrain the outputs of the other IC's to be in a state other than that defined by the gates truth table and input states.

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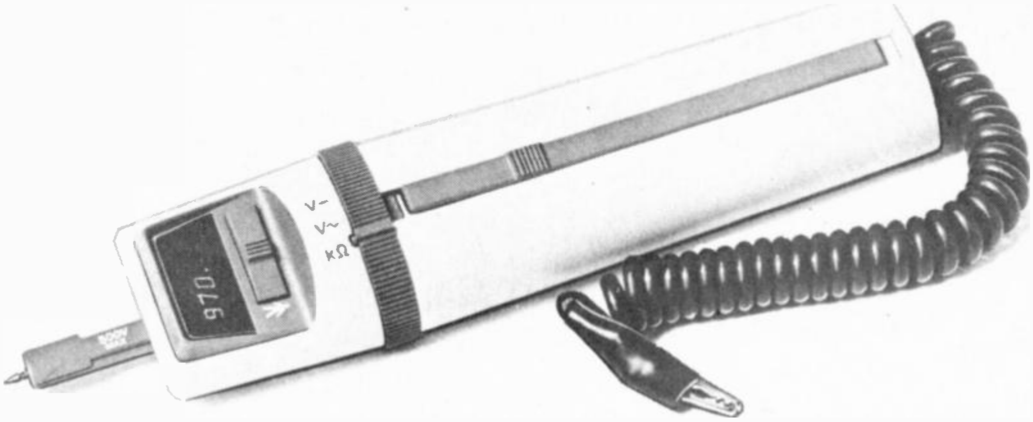

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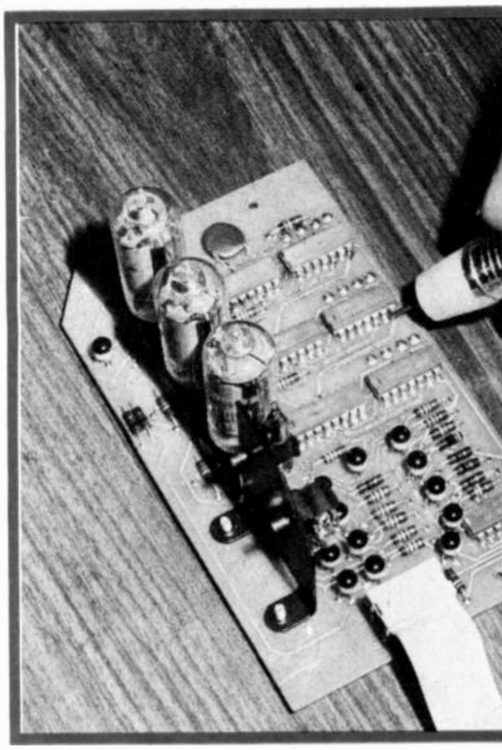


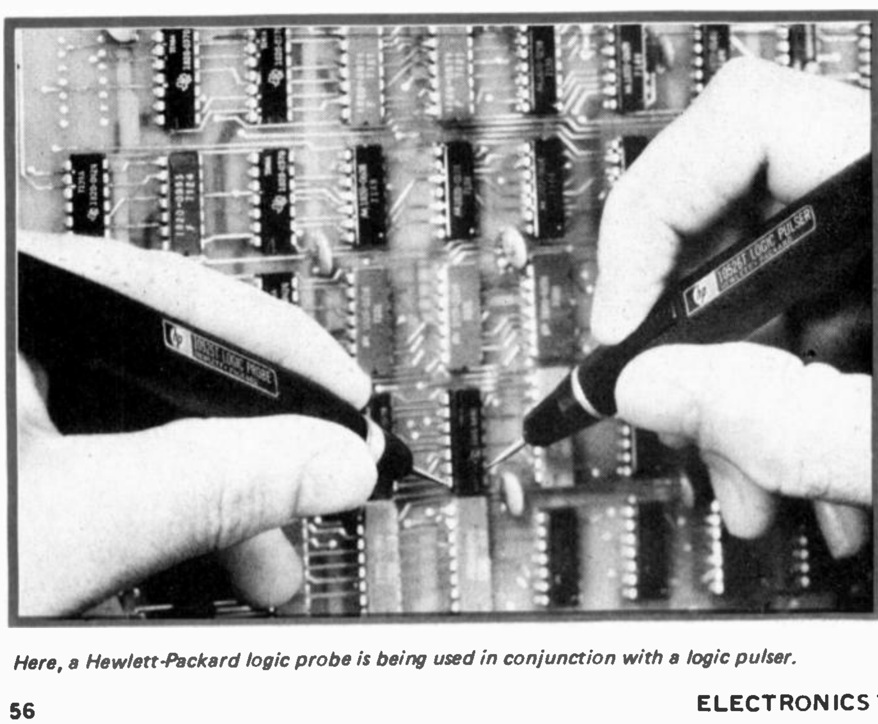
Digital fault finding is a quick and simple procedure — providing the right tools are used.

A LOGIC PROBE is a digital state indicator. It provides, at the user's finger tips, an indication of a high level, a low level, or bad level signal. Internal threshold indicators determine if the signal being probed is above the high threshold level, below the low threshold level, or somewhere between the two. Signal indication is given by a lamp that glows brightly for a high level, goes off for a low level, and glows dimly for a signal that is between the two thresholds. (Other types indicate signal state by different coloured lamps).

Since it is necessary to observe dynamic signal activity, as well as the static levels described above, logic probes usually have pulse stretching circuitry that can detect pulses as narrow as 10 ns and stretch them so that a readily visible blink can be seen. Thus if a low signal pulses high, the logic probe will blink 'on'. If a high signal pulses low, the probe will blink 'off'.

With some logic probes, such as Hewlett-Packard's 10525T, a pulse memory may be (in this case optionally) provided. This enables the probe to monitor a signal line for single shot or low frequency pulses over extended periods of time.

If a pulse occurs, this will be indicated by the device which will remain 'on' until reset by the user.



Here, a Hewlett-Packard logic probe is being used in conjunction with a logic pulser.

Probe will indicate pulse trains. It does this by blinking the lamp indicator at a constant rate (typically 10 Hz) when a pulse train is present.

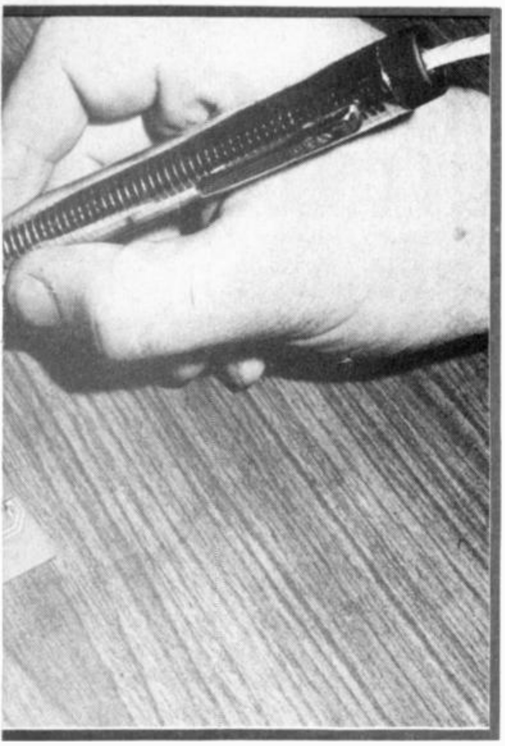
Thus a logic probe enables the user to view static signals, single shot pulses, and pulse trains. Automatic threshold detection is often included. This eliminates the need to determine repeatedly whether a signal is above or below the threshold.

Hewlett Packard's Logic Clip is another form of digital state indicator. It enables up to 16 signals to be observed simultaneously on a single IC. The Logic Clip has a single threshold level. If a signal on a given IC pin is above this threshold level an LED indicator light is turned on corresponding to that pin. If the signal is below this level the LED is turned off.

The Logic Clip differs from a logic probe in two important ways. First it has a single threshold as opposed to the two threshold levels in most logic probes. Because of this it will not indicate a bad level. Rather it will respond to a bad level signal in the same way a TTL or DTL gate will — as a high logic state. Apart from this, the HP Logic Clip does not have pulse stretching circuitry and therefore cannot be used to view high frequency or single shot narrow pulses.

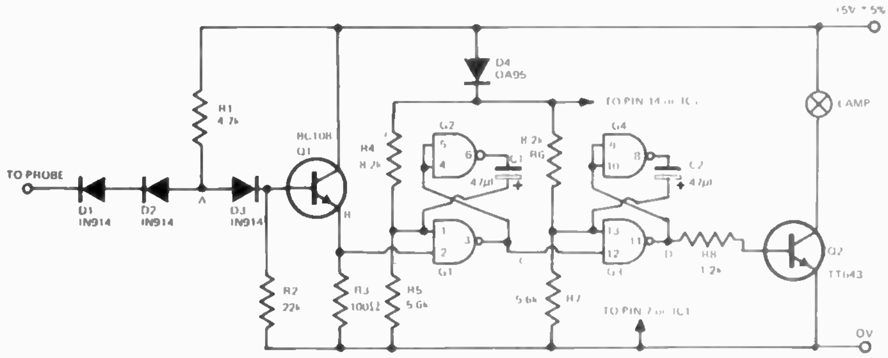
The advantage of the Logic Clip is that it has internal 'power seeking' circuitry. It cannot be attached improperly — regardless of how it is clipped onto the IC it will display the desired signal!

The ability to view signal activity on



This ETI-designed logic probe, described as a constructional project in our July 1971 issue – can be built far less than $15.

Circuit of the ETI probe.



several pins simultaneously is a tremendous time saver. Consider the problem of testing a decade counter (e.g. 7490). It is necessary to view at least one input and four outputs simultaneously to determine if this device is operating properly. With a Logic Clip this is no problem.

A Logic probe or HP Logic Clip provides a response mode of operation that is optimized to digital signals. But the mainstay of all troubleshooting is stimulus-response testing. It is necessary to apply a signal and observe the response to determine if the device is operating properly. As was pointed out previously this is very difficult to do in TTL circuits.

A logic pulser provides the solution. It may be used to inject into the circuit a single pulse of proper amplitude and polarity. If the node was low, it will be pulsed high and if it was high it will be pulsed low.

Thus it now becomes possible to jump rapidly from point to point in the circuit, applying pulses and observing the responses. Together the logic pulser, logic probe and logic clip provide total in-circuit stimulus response testing for all TTL, DTL, and other 5 volt logic.

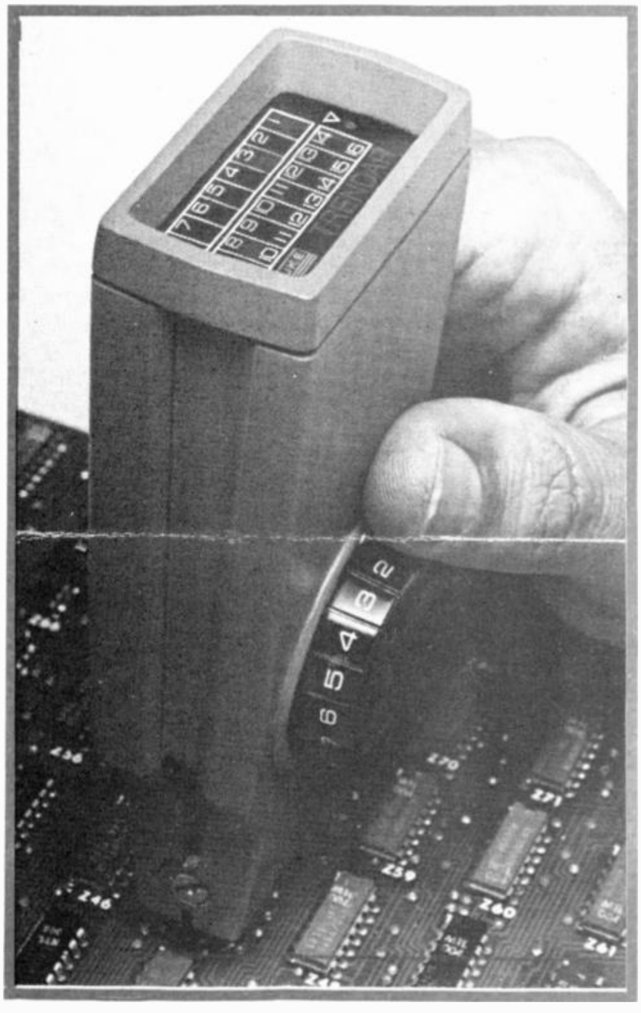
Other more sophisticated tools are available which test the IC, in-circuit, for correct operation in accordance with its truth table. Such a device is the Hewlett Packard 10529A Logic Comparator.

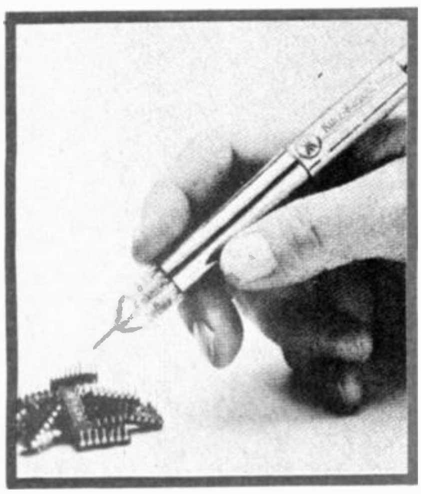
However, the three devices mentioned previously, offer a method of stimulus-response testing which is the mainstay of digital servicing. ●

This ingenious and versatile IC tester, recently released by Fluke, combines the functions of a logic probe, logic clip, and comparator in one single unit.

It functionally tests ICs while in circuit. A known-to-be-good IC of the type to be tested is inserted into a conventional socket. This is then plugged into the tester, which in turn, is snapped onto the IC to be tested. Internal circuitry 'sniffs out' Vcc and ground automatically powering the tester's internal circuitry.

The tester, known as the Trendar 200 IC Testclip, then displays – on an illuminated indicator – any difference between the reference IC and the IC under test.

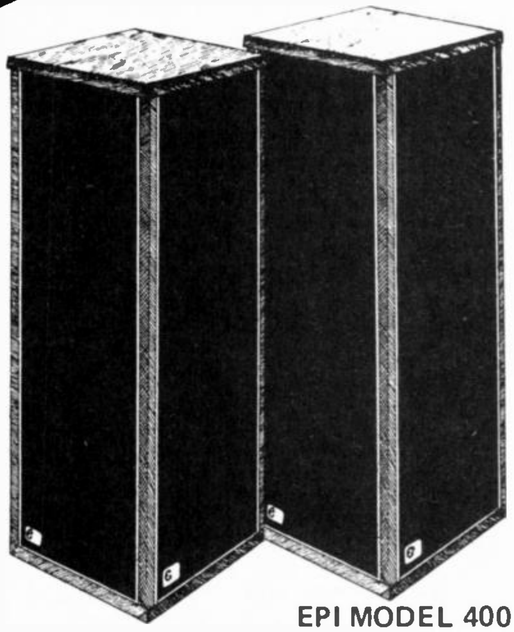




Typical logic probe is this unit from Kurz-Kasch. The readout indicates 'true', 'zero', or 'pulse' readings on two colour-coded lights in the probe tip. Absence of logic levels is shown by both indicator lights remaining off.

IMPORTANT NOTICE

TO ALL PEOPLE GENUINELY CONCERNED WITH SOUND REPRODUCTION —THIS ANNOUNCEMENT IS OF VITAL IMPORTANCE TO YOU



EPI MODEL 400

SOUND INVASION

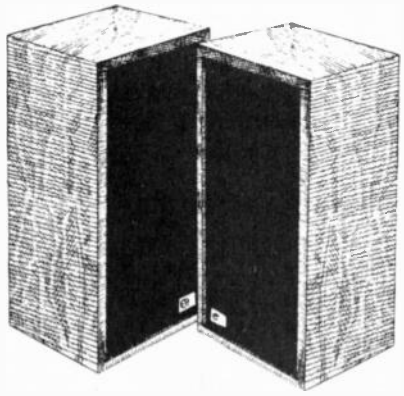
From Massachusetts USA the EPI linear loudspeakers representing their significant breakthrough in loudspeaker performance. Acclaimed by audiophiles throughout the world for such design accomplishments as the EPI Tower, which is rated by the "Stereophile" list as being one of the top five loudspeakers currently available in the world.

To those that are unfamiliar with EPI, the initials stand for Epicure Products Inc. The company is a collective of audio experts and engineers who banded together in 1968 to form a progressively minded company. Many of them had previously played a significant role in loudspeaker design and production for such organisations as AR (Acoustic Research) and KLH, but it was their realisation that the larger companies did not honestly want to offer linear loudspeakers to the consumer. This led EPI to the decision that a new company might successfully compete with the present day giants in producing speakers whose performance would not only be better but whose cost would be less.

EPI manufacture eight loudspeaker systems. Each system, in its own way, an attempt to provide what EPI believe to be the best possible sound reproduction in its price class. Ranging from the least expensive Model 50 "Mite," on which Audio Magazine in November 1971 commented:
"The response exceeds from 45-16000 ±3 dB and dispersion was also excellent in our listening test, the Model 50's transient response stood out and we found we could feed the unit a lot of power before it would break up. An open sound with clear highs and solid bass is characteristic of this stereo pair." To the most expensive Model 1000 Tower which produces the ultimate in sound qualify, but at 6½ ft tall, 180 lbs and $1000 each, these majestic columns are out of reach of all but the most devoted and enthusiastic music lovers.
Regardless of price and size all EPI speakers have a technically unbiased sound, that is, they are designed to reproduce the musical signal exactly as it is when it arrives at the loudspeaker terminals without colouration, tone compensation or added presence.

So may we suggest, before purchasing your loudspeakers, that you give careful consideration to your final choice and allow your ears to experience the accurate harmonics, low distortion, omnidirectional radiant energy and flawless transient response that make EPI speakers a never tiring experience.
For further information, brochure and dealer list: Please write to Auriema (A'Asia) P/L, Box 604, Brookvale, NSW 2100.

EPI MODEL 100



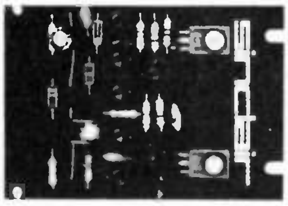
THE LINEAR RESPONSE OF EPI

OF MASSACHUSETTS USA

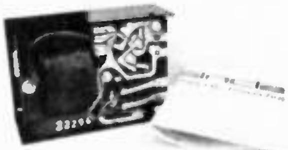
Dick Smith Electronics Centre

SCOOP PURCHASE OF SINCLAIR MODULES

Both these Sinclair offers are covered by usual guarantees etc. Beautifully finished and presented with comprehensive manuals. Why build when you can get ready built and tested so cheaply?

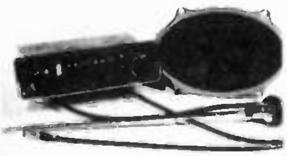


Z30 The ultralow (0.02%) distortion 40W (peak) amplifier that has been in such short supply. Operates from 8 to 35V without adjustment. Sig noise better than 70db. Input 250mV into 100k. 50 page manual covers everything (even servicing) with suggested systems. Ready wired and fully guaranteed. Recommended price $17.76. We were selling at $13.00 **NOW ONLY** $9.95. (Almost half price — that's what bulk buying does for you!) **PZ6** stabilised power supply delivers 35V at 1.5A with only 20mV ripple at max output. Don't build your own, it'll cost more and this one is so well designed. Recommended price $34. We used to sell at $26.50 but large purchase knocks price down to $19.75 (P&P $1.00).



Just In

JUST IN Solid State Car Radios. You know how hard it is to get a car radio at present? Well we've got hold of a great package deal. The SS9 (Nine semiconductors) radio complete with Lockdown aerial and speaker for just $42.95. SS12 (12 semiconductors) $49.95.

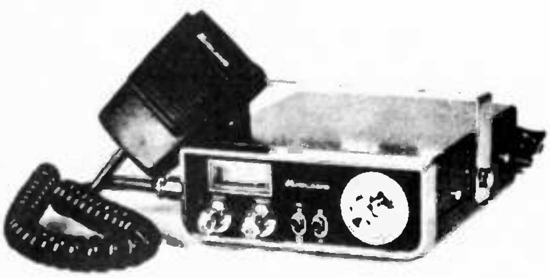


Handy Mains/ Battery Socket

Building equipment to run off mains and battery? Then you'll need our handy AS021 AP021 plug and socket combination. The socket has a built-in microswitch operated by the plug, so you get automatic change-over from battery to mains when plug is inserted. As used by professional equipment manufacturers. Saves flat batteries and is as cheap as conventional power connections. Socket AS021 50c Plug AP021 25c (Both P&P 30c).

Mystified by the panel below? Then turn back a page. We thought we'd celebrate the fact that E.A. is always published on the first Monday of the month. So have a good laugh!!!

Limited shipment of Transceivers (Licence Required)



5 Watt Mobile Transceiver 13-856 (PMG approved)

For mobile, or base station use. 16 transistor and 6 diodes. Meter indicates incoming signal strength and relative output power. 6 channels, squelch, noise limiter, P.A. facility. Suits + or −ve ground vehicles $97.50 (P&P $1.00).

Kits

Ultrasonic Experiments (E.A. Feb 74) uses the 105 transducers we are importing. Range to 80 feet. Transmitter kit $9.75. Receiver kit $19.75 or get the complete kit for $29.50.
Digital Voltmeter (E.A. Oct 73) uses the fantastic Analogue Devices Panelmeter. 3½ digit display. Max error ±0.05% +1 digit .200mV to 2kV and 20ohm to 200k. Complete kit $145 Panelmeter alone $102.
VHF Amp (E.A. Jan 74) only from us gives 30W out from 300mV at 144MHz from 12.6V 7W stage complete $11.50, 15W $13.50, 30W $17.50. Individual boards (specify $1.50 each. Or COMPLETE kit (saves $5) for $37.50.
Power controllers. The Popular DSE Superkits for motor control etc up to 750 Watts. DSE11 kit has 10A SCR all parts and circuit for only $5.75. DSE12 kit includes all the necessary hardware, case etc for $9.25.
VHF converter (E.A. Aug 73) wind your own coils for bands between 50 and 150MHz $21.50 ex metalwork.

Transistor Radio Bargain

Look at the picture. It's a handsome little job isn't it? 6 transistors, yes a proper superhet, in a tough handy case — fits your palm. Assembled by hand. Earphone included. Uses 1.5V battery (cheaper than usual ones!) You couldn't buy the parts for our price. In fact we've sold a few to people just for the parts!! A real knockout at $5.99 (P&P 75c) YES IT DOES WORK — I tried one out in my car all over Sydney and pulled in all local stations easily.

Have you got a CAT?

Dick's catalogue isn't just a price list. In fact it's hardly a catalogue since it contains so much useful information. Of the 64 pages over 20 are pure information. Like the IC data pages, 6 cover linears and digitals with suggested circuits too. Test gear, tools, amateur info. Pages on SCRS and triacs, books etc etc. Plus popular 50 cent discount vouchers and simple mail order form.

The big news is that the catalogue is FREE, just send the coupon below. YES a 64 page manual, 50 cent vouchers all for nothing. Send for yours now!

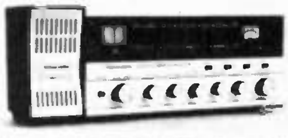
Quadraphonic sound

from your existing stereo.

Yes you don't need an extra amplifier when you fit the Quadronec Unit. This four channel decoder operates AFTER your amp. Simply buy two extra speakers and you can get the full quad effect! Has front rear balance and impact controls. Double stereo. Headphone connector. Get quadronised for only $75 (P&P $1.50).

Realistic Price Crash

The popular Realistic receiver has benefited from tariff cuts. Over 30 semiconductors. Tunes SW CW SSB AM Broadcast bands etc from 600kHz to 30MHz. Latest stock has CASCODE FET RF Amp. Variable BFO etc. Mains or Battery operation. Interesting manual tells you all about Short Wave Listening, so ideal beginners set and we give you FREE Australian Amateur Callsign book. Come in and hear one in our demo. lab you'll buy at only $185 (P&P $3.00).



Car Radio Quad Adaptor

The QD77 is a neat looking little unit to give the quad effect in your car. All you need is a couple of extra speakers. Separate Left and Right controls and 2 4 channel switch. Full Instructions. Gives a great effect for only $9.75.

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We have a few traded in car radios to clear for callers only. Save at least $30. All fully tested and in good condition. Ask in Hi Fi department.

Fibre Optic Fans

Fibre Optic Fans in stock again. A preformed fan of 20mil fibres, only needs a lamp base. With a bit of imagination and a good junk box you can make a very impressive display. Only $9.50.

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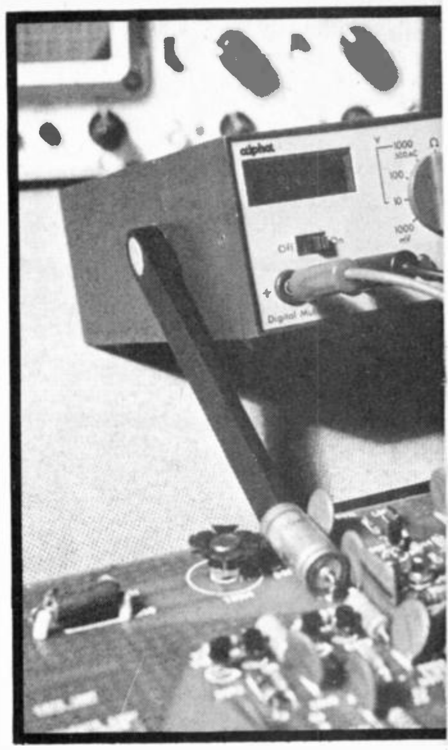
DIGITAL FAULT-FINDING METHODS



This logical testing procedure enables you to fault-find digital circuitry quickly and simply.

THE FIRST STEP in any trouble-shooting process is to narrow the malfunctioning area as much as possible by examining the observable characteristics of the failure. From the front panel operation (or rather mis-operation) the failure should be localised to as few circuits as possible. At this point it is necessary to narrow further the failure to one suspected circuit by looking for improper key signals between circuits. The logic probe can be every effective here.

In many cases, a signal will completely disappear. By rapidly probing the inter-connecting signal paths, a missing signal can be readily detected. Another important failure is the occurrence of a signal on a line that should not have had a signal. Logic probes have a pulse memory which allows such signal lines to be monitored for single shot pulses or pulse activity over extended periods of time. The occurrence of a signal will be stored and indicated by an LED.

Dependence upon a well-written service manual is the key to this phase of troubleshooting. Isolating a failure to a single circuit requires knowledge of the instrument or system and its operating characteristics. A well written manual will indicate key signals to be observed. The logic probe will provide a rapid means of observing the presence of these signals.

Once a failure has been isolated to a single circuit, the devices described above can be used to observe the effect of the failure on circuit operation and to locate the failure to its cause (either an IC or a fault in the circuit external to the IC).

The logic probe can be used to observe the signal activity on inputs and to view the resulting output signals. From this information, a decision can be made as to the proper operation of the IC. For example, if a clock signal is occurring on a decade counter and the enabling inputs (usually reset lines) are in the enabled state then the output should be counting. A logic probe will allow the clock and enabling inputs to be observed, and, if pulse activity is indicated on the outputs, then the IC can be assumed to be operating properly. As stated before, usually it is not necessary to see the actual timing of the output signals since IC's fail catastrophically. The occurrence of pulse activity is often enough indication of proper operation.

When more detailed study is desired or when input signal activity is missing, the logic pulser can be used to inject input signals and the Logic Clip or probe used to monitor the response. This technique is especially good when testing digital gates and other combinatorial devices. A logic pulser can be used to cause the inputs to go to a state which will cause a change in the output state. For example, a three-input NAND gate which has high, low, low inputs will have a high output. By pulsing the two low inputs high using a logic pulser the output will pulse low and can be detected by a logic probe. This then indicates that the IC is operating properly. A logic pulser is also valuable for replacing the clock in a digital circuit thus allowing the circuit to be single-stepped while the logic probe is used to observe the changes in the circuit's state.

The first step might be called the "mapping" step since the effect is to map out the problem areas for further investigation. It is important to do a complete "mapping" of the circuit before proceeding to analyse each of the indicated failures. Prematurely studying a fault can result in overlooking faults which cause multiple failures such as shorts between two nodes. This then often leads to the needless replacement of a good IC and much wasted time. With a complete trouble-area "map" we can begin to determine the type and cause of the failures. We do this by systematically eliminating the possible

DIGITAL FAULT-FINDING METHOD

1. Test all IC's using a logic probe or similar instrument. Note the failing nodes.
2. Check for an open output bond, driving the failing node using a logic probe. If an open bond is indicated, replace the IC driving the failing node.
3. Now test for a short to Vcc or GND using a logic pulser or probe. By simultaneously probing and pulsing the bad node, a short to Vcc or GND can be detected since the pulser is unable to inject a pulse into such a short.
4. Test for a short between two nodes using a logic probe and pulser — or an ohmmeter.
5. If the failure is not found in steps 2-4, then the failure, is either an open input bond or a failure of the internal circuitry of the IC driving the failing node. In either case the IC driving the failing node should be replaced.

Repeat steps 2-5 for each failing node observed in Test 1.

◀ *Simple digital fault-finding can be undertaken using a simple multimeter but it is a long tedious process.*

failures of digital circuits discussed above.

The first failure to test for is an open bond in the IC driving the failed node. A logic probe provides a quick and accurate test for this failure. If the output bond is open, then the node will float to a bad level. By probing the node, the logic probe will quickly indicate a bad level. If a bad level is indicated then the IC driving the node should be replaced and retested.

If the node is not a bad level then a test for a short to Vcc or ground should be made next. This can be done easily using a logic pulser and probe. While a logic pulser is powerful enough to over-ride even a low impedance TTL output it is not powerful enough to effect a change in state or a Vcc or ground bus. Thus if a logic pulser is used to inject a pulse while the logic probe is used simultaneously on the same node to observe the pulse, a short to Vcc or ground can be detected. The occurrence of a pulse indicates that the node is not shorted, and the absence of a pulse indicates the node is shorted to Vcc (if it is a high) or ground (if it is a low).

If the node is shorted to Vcc or ground there are two possible causes. The first is a short in the circuit external to the IC's and the other is a short internal to one of the IC's attached to the node. The external short should be detected by an examination of the circuit. If no external short is found then the cause is equally likely to be any one of the IC's attached to the node. The only suggestion that can be made (based upon experience) is to first replace the IC driving the node and if that does not solve the problem try each of the other IC's individually until the short is eliminated. (It might be noted that on occasion analogue components such as resistors or capacitors attached to the node have shorted).

If the node is not shorted to Vcc or ground, nor is it an open output bond, then we should look for a short between two nodes. This can be done in one of two ways. First the logic pulser can be used to pulse the failing node being studied and the logic probe can be used to observe each of the remaining failing nodes. If a short exists between the node being studied and one of the other failing nodes, then the pulser will cause the node being probed to change state (i.e. the probe will detect a pulse). To ensure that a short exists, the probe and pulser should be reversed and the test made again. As a further test or as another way of testing for a short between two nodes, the circuit can be removed from the instrument or system and an ohmmeter can be used to measure the impedance between the two failing nodes. A short between them will be easily detected.

If the failure is a short then there are two possible causes. The most likely is a problem in the circuit external to the IC's. This can be detected by physically examining the circuit and repairing any solder bridges or loose wire shorts found. Only if the two nodes which are shorted are common to one IC can the failure be internal to that IC. If after examining the circuit no short can be found external to the IC then the IC should be replaced.

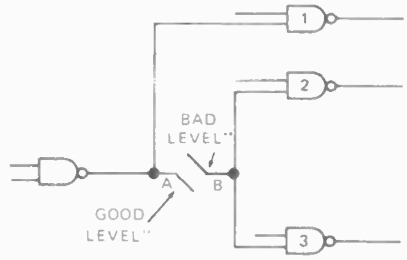
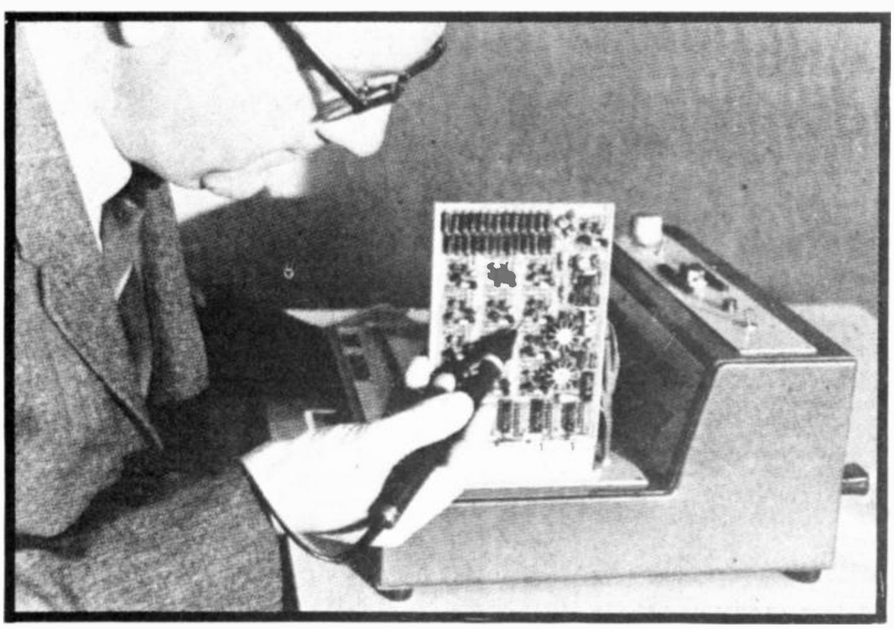


Fig.11. The effect of an open signal path external to the IC's. The open causes point B to float to a bad level while point A is driven by proper TTL or DTL signal levels. Starting at the input of gate 3 or 4 and proceeding back toward gate 1, the exact location of the open can be determined using a logic probe.

If the failure is not a short between two nodes then there are only two possibilities left. They are that the failure is an open input bond or a failure of the internal circuitry of the IC. In either case, this IC should now be replaced. Thus, by systematically eliminating the IC failures, the cause can be located.

An important step at any point where an IC is replaced is the retesting of the circuit. If the testing again indicates a failure, then more study of the problem must be made with the ▶



This logic test unit from Siemens allows PC boards to be tested by applying a programmed input bit pattern to the board and displaying corresponding board outputs. A separate logic probe is used to trace faults to specific IC's on the board.

(Continued from P.61)

knowledge that the failure is not in the IC that has just been replaced.

There is one type of failure that was not discussed, and that is an open signal path in the circuit external to the IC (Fig. 11).

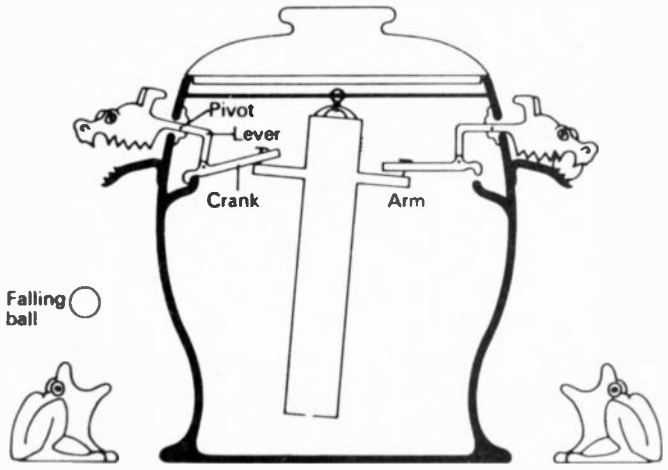
The logic probe provides a rapid means of not only detecting but also physically locating the open. Since an open signal path allows the input to the "right" of the open to float to a bad level, the logic probe can be used to test the input of each IC for a bad level. Once an input floating at a bad level is detected, the logic probe can be used to follow the circuit back from the input looking for the open. This can be done because the circuit to the "left" of the open will be a good logic level (either high, low, or pulsing) while the circuit to the right will be a bad level. Thus probing back along the signal path will indicate a bad level until the open is passed. Thus the probe can be used to locate precisely the open. The open can then be repaired and the circuit tested.

This systematic elimination of possible failures in digital circuits by the use of such special tools will ensure a rapid and accurate repair. Because these instruments provide a digital solution to the digital problem, improvements in servicing time of at least 4:1 are easily achieved.

We would like to thank the Marcom Division of Hewlett Packard, for their help in the preparation of this article.

WHAT WAS IT?

(page 79 ETI, March 1974)



It was a seismograph!

The device, a replica of which is now in London's Science Museum, was invented by Chinese mathematician-astronomer Chang Heng (AD78-AD139).

Heng's seismograph consists of a hollow bronze vessel about two metres in diameter containing a heavy pendulum suspended from a single top-located point.

The pendulum is extremely heavy, responding only to very low frequency vibrations, such as that produced by earth tremors.

Around the inside upper-periphery of the housing a series of catches control the opening of the dragon's mouths. A further locking mechanism grips the pendulum — once a catch has been actuated — preventing any subsequent response to seismic shocks from other directions.

Thus, at the first earth tremor, the pendulum swings — toward the disturbance's epicentre — unlocking a catch, which in turn allows a dragon to drop a ball into the mouth of the frog directly beneath. The frog, now holding the ball, indicates the direction of the earth tremor.

The instrument was used for several hundred years in the earthquake-prone city of Sian, the capitol of China during the Han dynasty.

Chang Heng's pendulum principle was forgotten at some time between the sixth and thirteenth centuries.

It was not until the 19th century that the principle of the pendulum seismograph was rediscovered.

Western knowledge of this instrument, and other early Chinese scientific and technological achievements are largely due to Joseph Needham's massive work 'Science and Civilization in China' (Cambridge University Press). ●

The first of many correct entries received was from Mr. B. Begg of Padstow Heights s.
Congratulations Mr. Begg. You win a year's free subscription.

The scientific instrument on page 79 of March 1974 Electronics Today is a

候風地動儀

or, in Mandarin Chinese HÒU FĒNG DÌ DÒNG YÍ or, translated literally, into English, Time, Wind, Earth Move Instrument.

Yours faithfully L. Ahearn.

"I believe the object is a brazier used in early hot air balloons".

"The device illustrates the difference in thermal expansion of dissimilar alloys".

"It measures the expansion of brass with heat".

"A samovar, an interior heat-tube keeps water at boiling point for making tea".

"It is a Leyden Jar — a way of accumulating charge".

"A decorative version of a perpetual motion machine".

Or a device for calculating to the base of eight".

"It's a clock".

"A generator of static electricity".

Now you Dolby*...

With standard low noise Sony cassettes, reproduction from these models is superb. With Sony chromium dioxide cassettes it's sensational!

now you don't!

Sony comes on strong with two superb stereo cassette tape decks with Ferrite and Ferrite heads.

Sony unveils its new TC-129 tape deck as a perfect companion to the immensely popular TC-134SD deck! Both have Sony's precisely engineered Ferrite and Ferrite head for fully extended frequency response, excellent signal-to-noise ratio and up to 200 times the life of conventional heads. Both have tape selector switch for optimum adaption from conventional tapes to CrO_2 tapes such as Sony's chromium dioxide cassette tape. Both have manual control stereo recording sliding-type recording volume controls for each channel and dual motor for easy balance control. Both have instant stop mechanism with locking pause control. Both have mechanical/auto stop which automatically shuts the tape transport off when the tape reaches its end. Each has 3-digit tape counter with reset button; headphone jack to accept 8-ohm impedance; microphone jack for MIC/LINE; REC/PB connector. Both are superbly styled. Then what's the difference—apart from their physical layout? Frequency response on the TC-129 is 40Hz-12000Hz with normal tape. 40Hz-14000Hz with CrO_2 tape. On the TC-134SD it's 30Hz-15000Hz normal tape, 30Hz-17000Hz with CrO_2 tape. The TC-129 has its own hinged detachable dust cover. The 134SD has the famous Dolby system to extend response and reduce tape hiss. Both are fantastic value. The choice is yours.

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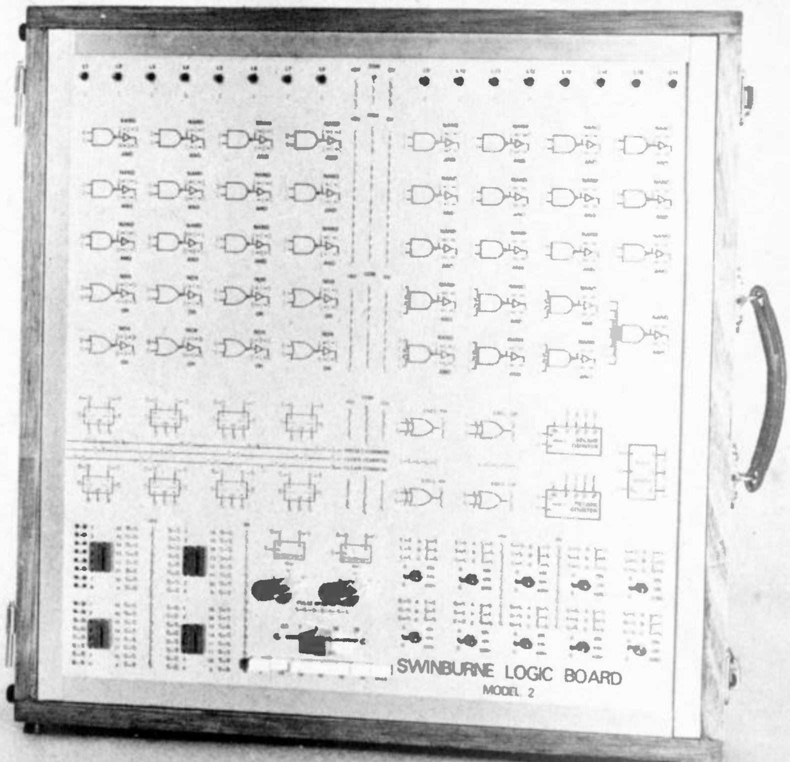
JK5967

LOGIC TRAINER



Australian-made logic boards, from Integral Design, are suitable as research and design tools as well as instructional aids.

TWO different models of a digital bread-board system have recently been marketed by Integral Design, a young Melbourne company. A complete list of the available functions is given in Table 1, and the photographs show the front panel and interior of their smaller unit (Model 2).

The units were designed in close collaboration with Swinburne College of Technology, and, as they are intended primarily as a teaching aid, much effort has been put into optimizing the layout for clarity and ease of operation. So much so that it is claimed that a student can use these logic boards effectively after only two or three minutes of familiarization.

The use of combined AND/NAND and OR/NOR gates considerably improves the flexibility of the units by effectively doubling the gate capacity of the logic boards.

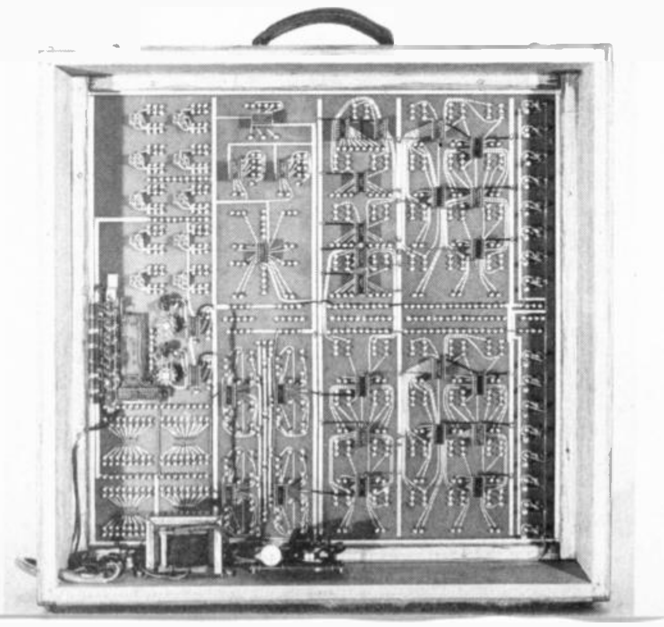
Finish and construction of the units are superb. The front panel is in fact a single large printed circuit board 2.4 mm thick. The front of the board is coated with buff coloured epoxy paint and the logic functions are screen printed over this in brown.

Printed circuit tracks, which interconnect the ICs switches etc, on the rear of the panel are gold-plated. Additionally the plugs and sockets used (3 mm diameter) are gold-plated to improve appearance, provide extended life and reduce contact resistance. The sockets, which pass through the board, are riveted from the front and soldered to the PC track on the rear to ensure good contact with the track.

TTL, or TTL compatible circuitry has been used throughout and the units are said to be overload and student proof. As well as being suitable for instruction, the boards may be used in many industrial applications. They may be used for testing logic and counting circuitry for example thus avoiding the problems and expense of prototyping. Further they may be used as a programmable tester for prototype and production logic circuitry — much of which can be plugged in directly.

Further information regarding these boards may be obtained from:

Integral Design,
105 Hawthorn Road,
Caulfield, Vic. 3161.



Interior of the logic board showing the gold plated track and the IC's which are all socket mounted.

MUSIC

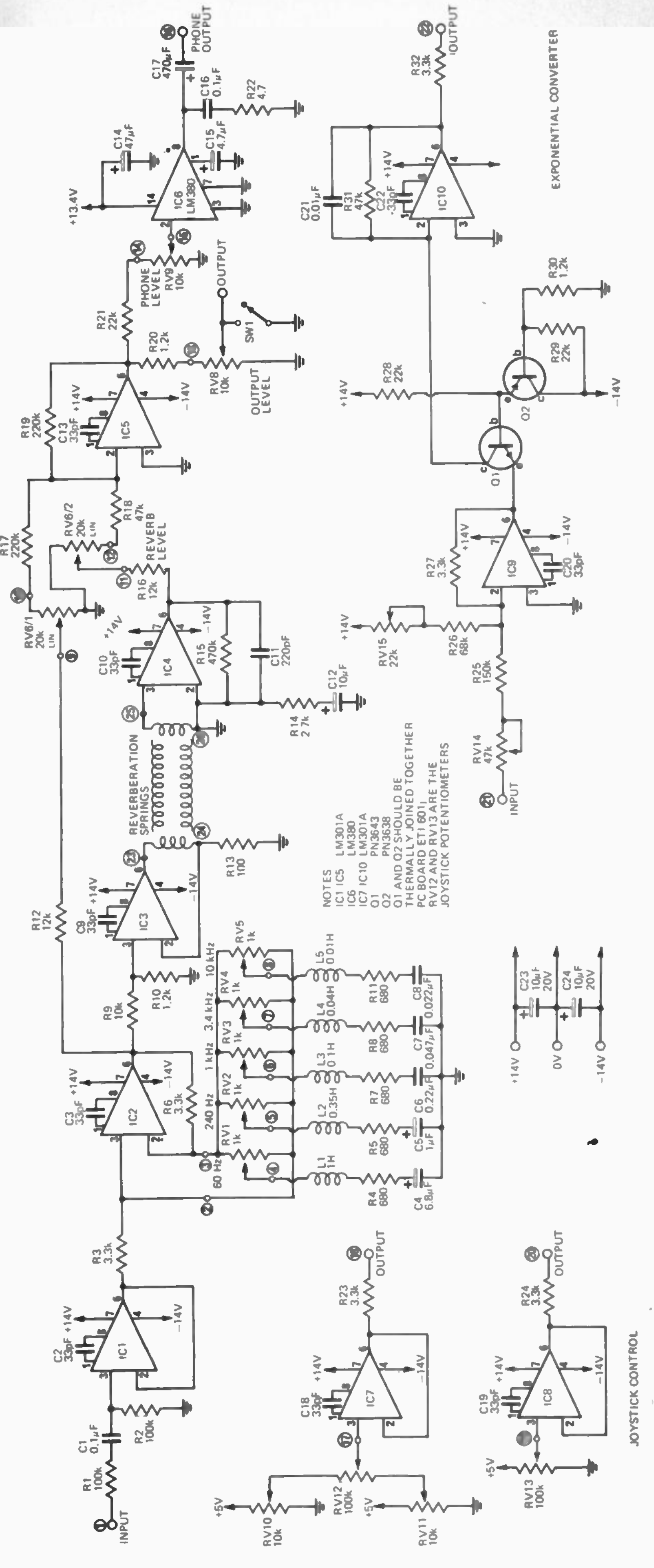


Fig. 1. Circuit diagram of the complete output stage, equalizer and exponential converter etc.

IN THIS issue we describe the output module which contains the equalizer, reverberation and output amplifiers as well as the joystick control buffers and an exponential converter.

CONSTRUCTION

The same procedure should be followed as previously described for other modules. Assemble the printed circuit board in accordance with the component overlay, Fig. 2., taking care with the orientation of polarized components. Wire the potentiometers and switches in accordance with Fig. 3.

CALIBRATION

The exponential converter is the only section of the circuitry that requires calibration. This should be carried out by applying 0 V to the input and adjusting RV15 to obtain 0.156 V, and then by applying 5 volts to the input and adjusting RV14 to obtain 5 volts output. The 0 V input should then be rechecked and the input/output relationship detailed in Table 1 should then exist. This characteristic ensures that a 1 volt change in input voltage will produce an output that, when applied to an oscillator or filter, will change its frequency by one octave. Thus a 5 volt input range provides a five octave frequency range.

The control range may be extended by reducing the 0.15V volt output at 0 volt input (R26 may need to be increased to obtain required range) however the 1 volt/octave relationship will no longer apply.

HOW IT WORKS

OUTPUT MODULE

This section can be broken into sections as follows.

- INPUT BUFFER
- EQUALIZER
- REVERBERATION
- OUTPUT AMPLIFIER
- HEAD PHONE AMPLIFIER
- JOYSTICK BUFFERS
- EXPONENTIAL CONVERTER

The input buffer (IC1) has a 200 kΩ input impedance and gives an attenuation of 6 dB (½). The attenuation is required to prevent clipping in the equalizer output stage.

The output from the buffer is directly coupled to the input of the equalizer stage. This stage is a little unusual, since the equalizing networks are arranged to vary the negative feedback. If we consider one

INTERNATIONAL SYNTHESIZER

section with the others disconnected, at the resonant frequency of the series LCR combination the impedance of the entire network will be equal to 680 ohms. Either side of resonance the impedance of the network will increase (with a slope dependent on the Q of the network), due to uncancelled inductive reactance above resonance and uncancelled capacitive reactance below resonance. We can therefore represent the equalizer stage with equivalent circuits as reproduced below. These circuits consider only one network is in circuit, the input signal frequency is the resonant frequency of the network, and the resistance of the inductor is negligible.

With the slider of the potentiometer at the top end (Fig. A) we have 680 ohms to the zero volt line from pin 2 of IC2, and a 1 k ohm between pin 3 and pin 2. The IC will act due to the feedback to keep the potential between pins 2 and 3 virtually zero, thus there is zero current through RV1. The voltage on pin 3 (IC2) is therefore equal to the output of the mixer since there is virtually no current through and no voltage drop across R3.

The output of IC2 in this case is approximately the input signal times (R6 + 680)/680 ohms, indicating a gain of about 15 dB. If the slider is at the other end of the potentiometer (Fig. B) the signal appearing at pin 3 and thus also at pin 2 is about 0.2 of the output of the previous stage due to the voltage division of R3 and the 680Ω. There is still zero current through RV1 and also zero current through R6 since there is no path. The output voltage is therefore the same as that at pin 2, which happens to be about 0.2 times the ouput of the previous stage. The gain is therefore 0.2 – or –13 dB.

With all networks in circuit, the maximum boost and cut will be reduced, but a range of ± 10 dB is still available. With the wiper of the potentiometers set midway – Fig. C, the gain will be unity regardless of frequency, due to the symmetry of the entire network.

The equalizer output is attenuated by about 20 dB (0.1) and fed into the reverb driver IC3. The reverb is connected in the feedback of the IC in such a way that the drive is a constant current and not a constant voltage. This drive method provides a more uniform frequency response. Note that both sides of the input drive coil must be isolated from earth. This is achieved by removing the existing RCA socket and replacing it with an *insulated* socket making sure that it is completely isolated from the frame.

The output of the reverb unit is a very low amplitude signal which is amplified by IC4. The output of IC4 and the output of the equalizer (IC2) both go to RV6 which selects the percentage of each required.

The final amplifier, IC5, amplifies the output of RV6 and applies it to RV8 which adjusts the output level to the main amplifier. The output of IC5 also goes to the headphone amplifier IC6 (LM380). This IC will supply up to 1.5 watts into either headphones or a small loudspeaker.

The joystick simply supplies two voltages which vary between 0 and +5 V. The horizontal axis has both ends of the control potentiometer adjustable between 0 V and +5 V so that the range can be reduced or even reversed. Buffer amplifiers IC7 and IC8 prevent loading of the control potentiometers.

The exponential converter consists of IC9, Q1, Q2 and IC10. The input signal is inverted and attenuated by IC9. Potentiometer RV14 adjusts the gain and RV15 provides the required offset. The exponential relationship between the base-emitter voltage and collector current of a transistor (Q1) is used to provide the required law. Transistor Q2 provides temperature compensation. Note that Q1 and Q2 must be glued together to provide intimate thermal contact (see photograph). The collector current of Q1 is converted into a proportional voltage thus providing the input/output relationship detailed in Table 1.

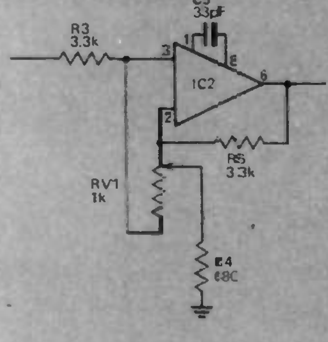


Fig.A. Equivalent circuit of the equalizer with potentiometer set for maximum boost at the resonant frequency of the network.

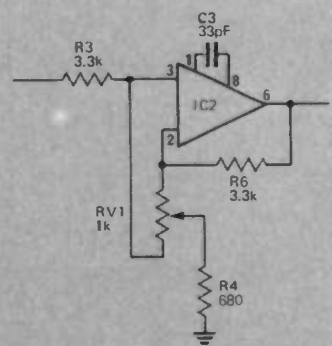


Fig.B. Equivalent circuit of the equalizer with the potentiometer set for maximum cut at the resonant frequency of the network.

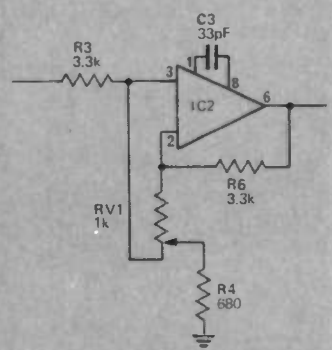
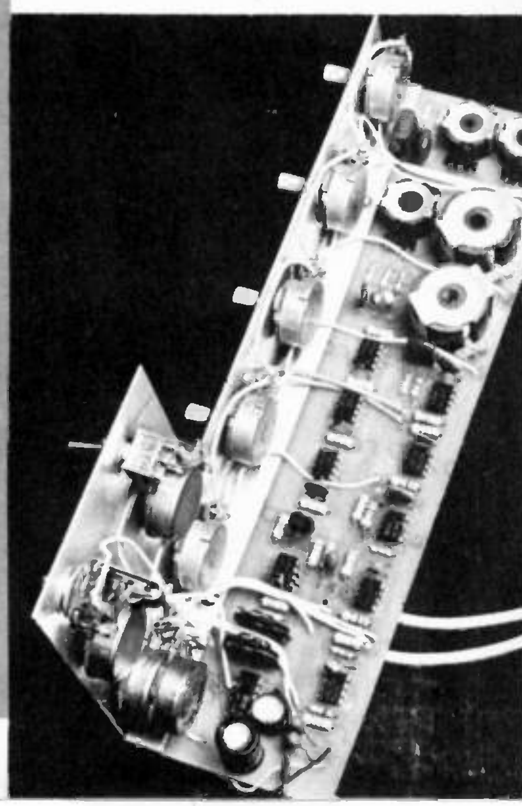


Fig.C. Equivalent circuit of the equalizer with the potentiometer set for unity gain regardless of frequency.

The output module.



PARTS LIST

OUTPUT STAGE

R22,	Resistor	4.7Ω	¼W	5%
R13	"	100Ω	"	"
R4,5,7,8,11	"	680Ω	"	"
R10,20,30	"	1.2k	"	"
R14	"	2.7k	"	"
R3,6,23	"	3.3k	"	"
R24,27,32	"	3.3k	"	"
R9	"	10k	"	"
R12,16	"	12k	"	"
R21,28,29	"	22k	"	"
R18,31	"	47k	"	"
R26	"	68k	"	"
R1,2	"	100k	"	"
R25	"	150k	"	"
R17,19	"	220k	"	"
R15	"	470k	"	"
RV1-5	Potentiometer	1k	lin rotary	
RV6	"	20k	dual lin rotary	
RV8,9	"	10k	log rotary	
RV10,11	"	10k	lin rotary	
RV12,13	"	special 100k joystick		
RV14	"	47k	trim	
RV15	"	22k	trim	
C2,3,9	Capacitor	33F	Ceramic	
C10,13,18	"	33F	"	
C19,20,22	"	33F	"	
C11	"	220μF	"	
C21	"	0.01μF	Polyester	
C8	"	0.022μF	"	
C7	"	0.047μF	"	
C1,16	"	0.1μF	"	
C6	"	0.22μF	"	
C5	"	1μF	35V	PC electrolytic
C15	"	4.7μF	25V	"
C4,	"	6.8μF	20V	"
C12,23,24	"	10μF	20V	"
C14	"	47μF	20V	"
C17	"	470μF	10V	"
IC1-5	Integrated circuit	LM301A	miniclip	
IC7-10	"	LM301A	"	
IC6	"	LM380	14 pin DIL	
Q1	Transistor	PN3643		
Q2	"	PN3638		
L1	Choke	1H		
L2	"	0.35H		
L3	"	100mH		
L4	"	40mH		
L5	"	10mH		

Reverb spring Plessey type 51 or equivalent
Metal bracket to Fig
SW1 toggle switch SPST
6.5 mm phone socket.

TABLE 1. CALIBRATION EXPONENTIAL CONVERTER

INPUT	OUTPUT
0V	0.15625V *
1V	0.3125V
2V	0.625V
3V	1.25V
4V	2.5V
5V	5V **
6V	10V

* adjust RV15 with 0V input to obtain 0.156V output.
** adjust RV14 with 5V input to obtain 5V output
(note that these adjustments must be done in the above sequence).

TABLE 2. WINDING DATA EQUALIZER CHOKES

L1 1000 turns 34 B&S			
	Ferrite Core	Philips	4322-022-29310
	Former	Philips	4302-021-20030
	Clip	Philips	4302-021-20020
L2 585 turns 32 B&S			
	Core, former clip same as L1		
L3 460 turns 34 B&S			
	Ferrite Core	Philips	4322-020-24280
	Former	Philips	4302-021-20010
	Clip	Philips	4302-021-20000
L4 300 turns 34 B&S			
	Core, former and clip same as L3		
L5 150 turns 32 B&S			
	Core, former and clip same as L3		

ERRATA

Music Synthesizer. March 1974, page 76 Parts List — Voltage Controlled Filter. 7th line should read R12, 13, 16 not R7, 8, 14 as shown.

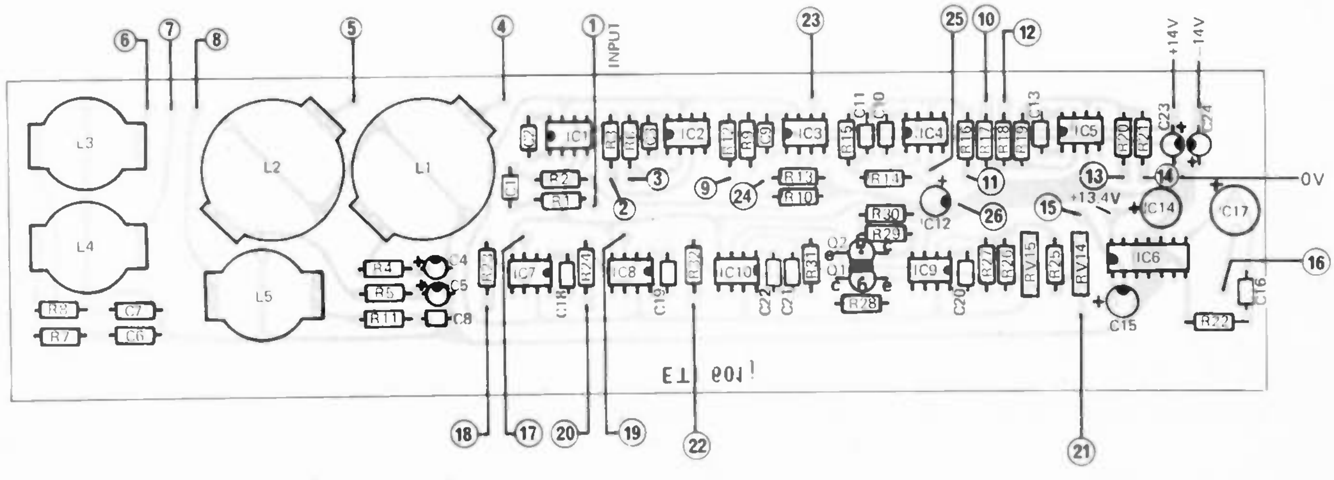


Fig.2. Component overlay for the output module.

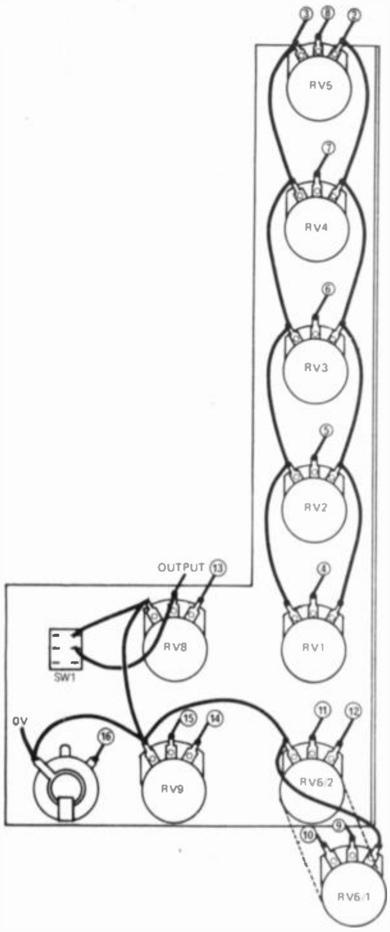


Fig.3. Wiring to output module potentiometers.

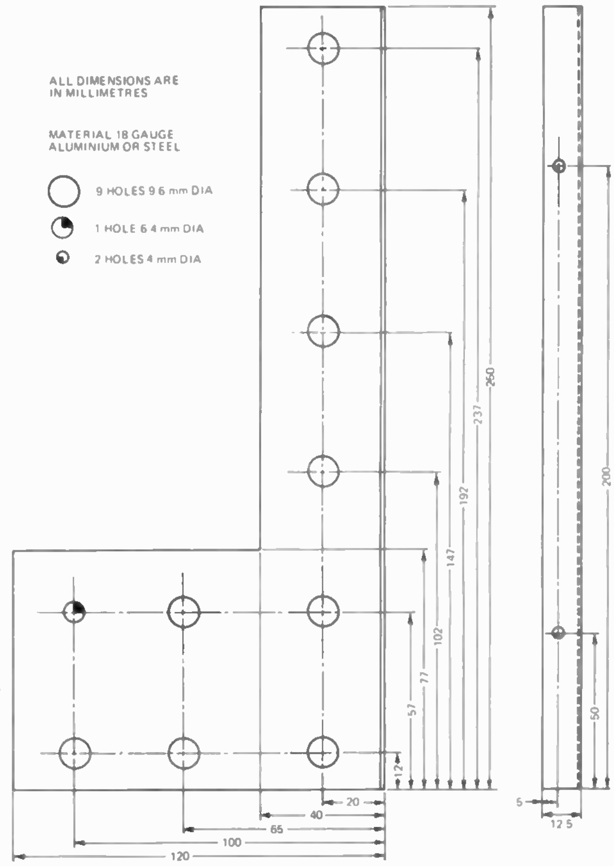
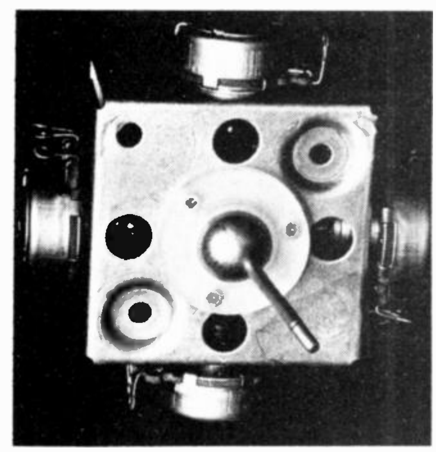
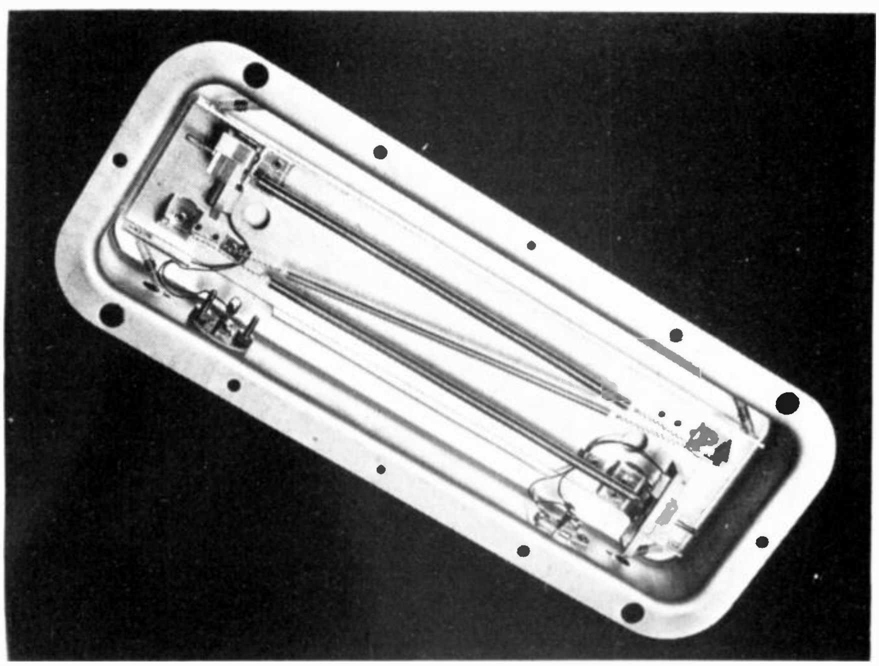


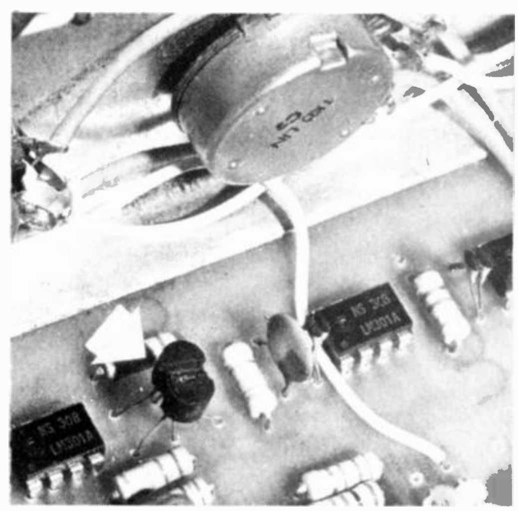
Fig.4. Drilling details of output module sub-panel.

The joystick control potentiometer (available shortly from John Carr Pty Ltd).





Interior of the spring-reverberation unit. The insulated RCA socket may be seen on the left.



The exponential converter transistors Q1 and Q2 (arrowed) are glued together to ensure thermal balance.

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61 4991, WOLLONGONG: 84 8022.

SPECIFICATIONS

Tuner section

Frequency range:	FM 87.5 - 108MHz (3.43 - 2.78m) AM 530 - 1,605kHz (566 - 167m)
Antenna system:	FM Built-in telescopic antenna External antenna jacks (with EAC-- antenna connector) AM Built-in ferrite bar antenna

Cassette-corder section

Recording system:	4-track, 2-channel stereo recording and playback
Tape:	SONY compact cassettes, C-60, C-60HF, C-90, C-90HF, C-120, C-120HF or equivalent, or chromium dioxide tape
Tape speed:	1 7/8 ips (4.8cm/s)
Frequency response:	50 - 10,000Hz (Tape selector, NORMAL) with standard cassette 50 - 13,000Hz (Tape selector, SPECIAL) with chromium dioxide tape
Signal-to-noise ratio:	45dB
Flutter and wow:	0.22%
Harmonic distortion:	2.5%
Recording time:	2 hours with C-120 cassette (both sides)
Inputs:	Microphone, sensitivity −72dB (0.2mV) low microphone impedance Line in, sensitivity −22dB (0.06V) input impedance 100k ohms
Outputs:	Line out, output level 0dB (0.775V) load impedance, 100k ohms Headphones, load impedance 8 ohms

General

Power output:	3 watts (both channels)
Speakers:	5×3 1/2" (12×8cm) .... 2 4×3" (10×7cm) 2
Semiconductors:	21 transistors for tuner 2 FETs and 11 transistors for auxiliarv circuit
Power consumption:	AC 8W
Power requirements:	AC 110, 127, 220, 240V (for Europe) AC 100, 110 - 120, 220 - 240V (selectable with a voltage selector) 50/60Hz DC 6V—4 "D" size (UM-1) flashlight batteries, rechargeable battery (BP-B) car battery with car battery cord DCC-126
Dimensions:	13 1/8(W)×9 5/8(H)×4 11/16"(D) (334×244×119mm)
Weight:	11 lb 11 oz (5.3kg)
Accessories:	Demonstration cassette AC power cord DK-17 Head cleaning tips
Optional accessories:	Microphones ECM-99, F-99S FM wireless microphone CRT-30 Rechargeable battery BP-B Car battery cord DCC-126 Connecting cord RK-74 Headphones DR-4A, DR-5A Stereo earphone ME-26 External antenna connector EAC-4 Head cleaning kit KK-1

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NEWCASTLE, NSW AGENT Digitronics Aust. Pty. Ltd., 12 William Street, Maryville, NSW, 2293. Phone 69-2040

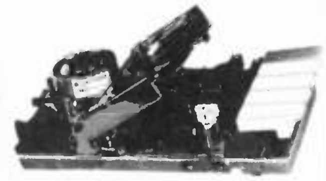
NTH QUEENSLAND AGENT Philtronics Cnr. Grendon and Palmer Sts., Nth Mackay, Qld. 4740. Ph: 78855

HUNTER VALLEY N.S.W. Hunter Valley Electronics and Hi-Fi, 478 High St., MAITLAND. N.S.W. 2320. Phone: 33-6664

DUBBO, NSW AGENT A & R Olsen 34 Church St., Dubbo 2830. Ph: 82-2300.

WEST AUSTRALIAN AGENT B.P. Electronics, 192-196 Stirling Terr., Albany, W.A. 6330. Ph: 41-3427

VORTEX STEREO CASSETTE DECK



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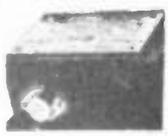

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This stereo monitor indicates by LED indication over driving or clipping due to peak music transients. **$6.50** Post 50c

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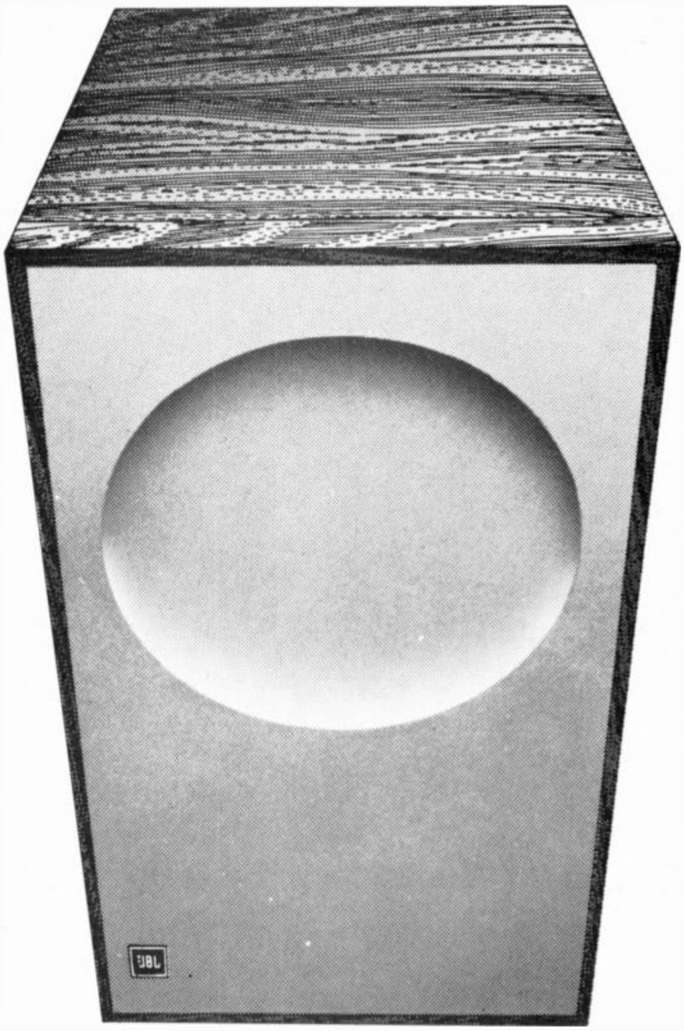
This new IC electronic thermomenter enables temperature measurements to be made from up to seven points. **$59.00** Post $1.50

100W POWER AMPLIFIER ETI 413
An easy-to-build high powered amp with power supply for PA., guitar, organ etc. **$65.00** Post $2.00

MIXER PRE-AMPLIFIER ETI 419
A professional IC pre-amp with bass and treble controls and four input mixing. **$9.50** Post 50c

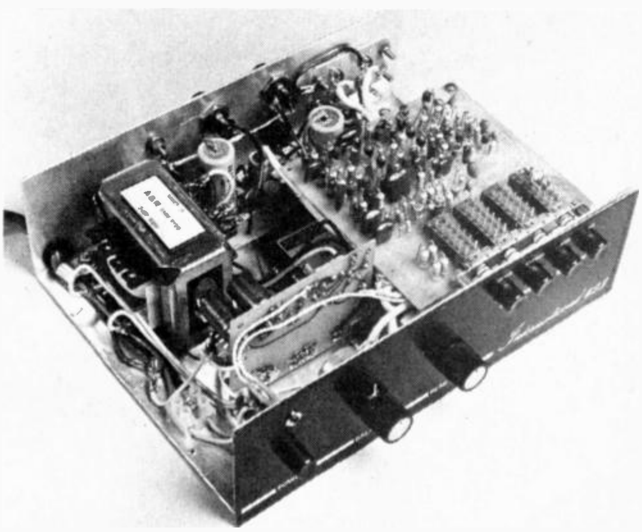
DIGITAL STOP-WATCH
Measure elapsed time electronically — may be used as stopwatch, start/stop timer or lap timer. Includes HP LED display. **$92.00** Post $1.50

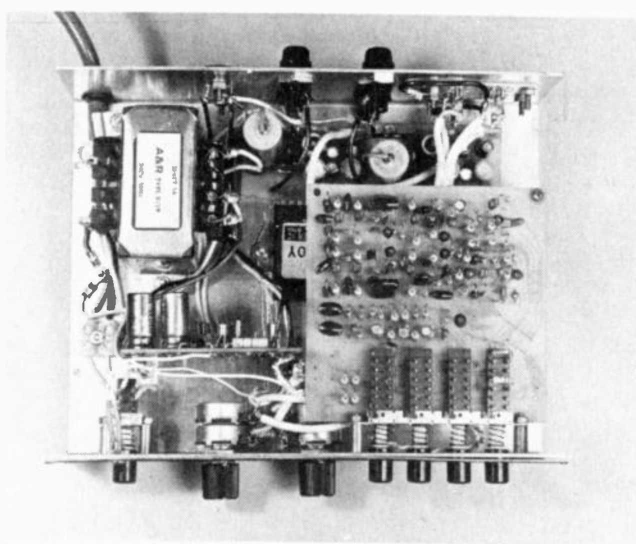


PROJECT 423

PLUS TWO add~on decoder amplifier

Adapt your stereo hi-fi to full four-channel SQ operation – for under $60!





SPECIFICATION

Output Power (at 1% distortion)			
Both channels driven	12.5 watts per channel		
Distortion	100 Hz	1 kHz	10 kHz
At 0.1 watt output	0.15%	0.13%	0.25%
At 1 watt output	0.14%	0.11%	0.18%
At 10 watt output	0.14%	0.1%	0.15%
Maximum Input Voltage	2 V		
Gain			
Input to front output	Unity		
Damping Factor			
100 Hz	5		
1 kHz	30		
10 kHz	30		
SQ Decoder Phase Shift			
30 Hz to 20 kHz	90° ± 10°		

MANY OF US have watched the evolution of four-channel systems with interest, but, being already possessors of a stereo system, have rejected four-channel as being too expensive to implement.

But here is a cheap and relatively simple way to convert your stereo into a full SQ, four-channel system. Apart from this unit the only extra equipment needed are two rear speakers, which need not be as high in quality as your existing front speakers.

The add-on unit is connected to your existing stereo amplifier via the pre-amplifier 'out' and main amplifier 'in' sockets. This facility — together with a 'connect/disconnect' switch is provided on most good quality amplifiers. If it is not, your existing amplifier must be modified by disconnecting the internal wiring and bringing all four points out to the rear panel via shielded cable.

Although this is a quick simple modification, it should only be attempted by those who have a good understanding of amplifier operation — if you don't know how to do it — do obtain advice.

The add-on unit's mode of operation may be readily understood by referring to Fig. 1. It will be seen that the SQ matrixed signals are amplified by the existing preamplifier tone control stages, and then passed to the add-on unit. Here they are decoded into left front, right front, left back and right back channels. The left and right back channels are amplified and passed direct to the rear speakers. The left and right front signals are passed back to the existing main amplifiers and speakers, and there you have it — inexpensive four-channel sound.

The discrete decoder board described last month, is used in the add-on unit. Alternatively the decoder board described in the January 1974 edition may be used, although the MC1312P integrated circuit is extremely difficult (if not impossible) to obtain at present.

The power amplifier module uses the Sanken SI-1010Y modules and is

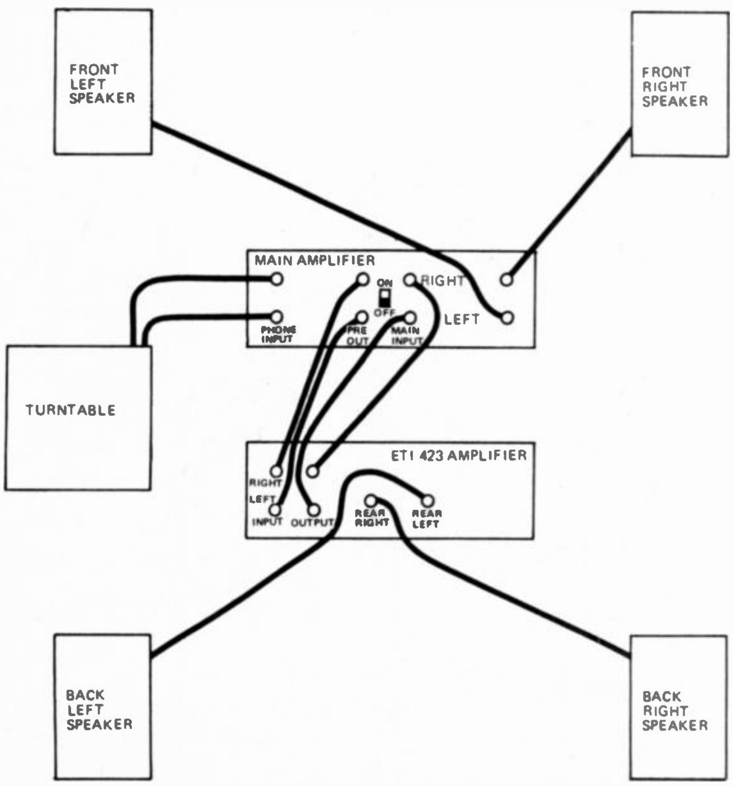


Fig. 1. This schematic drawing shows how the add-on unit is connected into the existing stereo system.

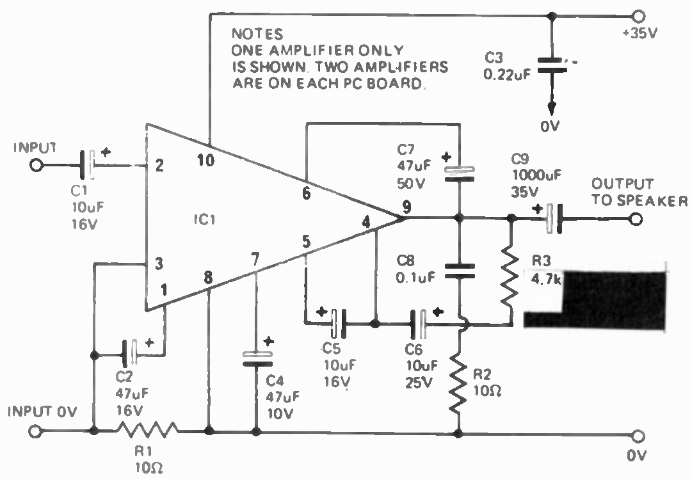


Fig. 2. Circuit diagram of one power amplifier module (two per assembly).

PLUS TWO add-on decoder amplifier

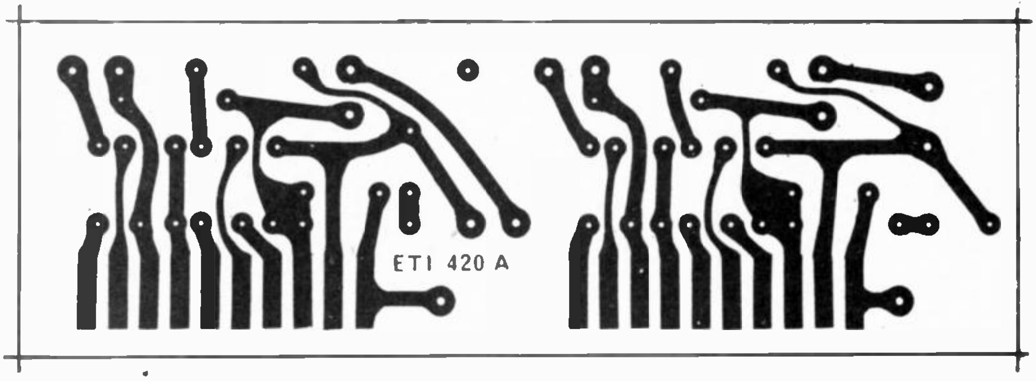


Fig. 3. Printed circuit board for the twin power amplifier assembly.

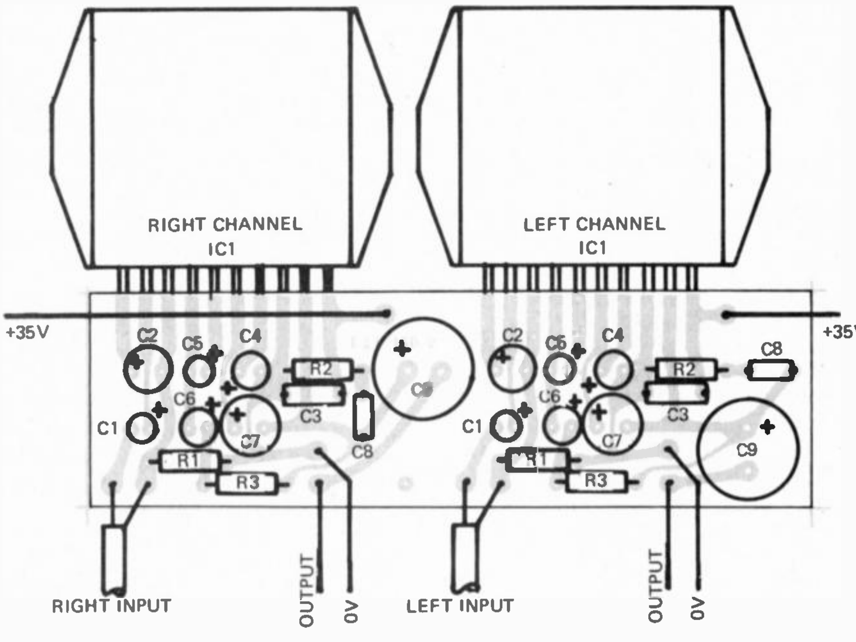


Fig. 4. Component overlay for the twin power amplifier assembly.

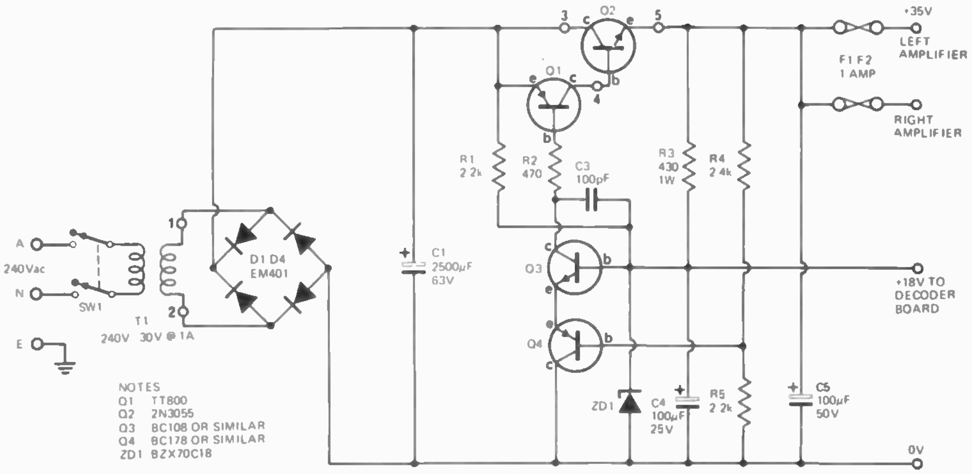


Fig. 5. Circuit diagram of power supply.

PARTS LIST

POWER SUPPLY

R1 Resistor 2.2k ½W 5%
R2 " 470 " "
R3 " 430 1W "
R4 " 2.4k ½W "
R5 " 2.2k " "

C1 Capacitor 2500µF 63V electrolytic
C3 " 100pF ceramic
C4 " 100µF 25V electrolytic PC mounting
C5 " 100µF 50V electrolytic PC mounting

Q1 Transistor TT800 or similar
Q2 " 2N3055 or similar
Q3 " BC108 or similar
Q4 " BC178 or similar

D1-D4 Diode EM401 or similar
ZD1 Zener Diode BZX70C18

T1 Transformer 240V/30V @ 1A A & R 9129 or equivalent.
SW1 Switch McMurdo Type 2904-1
PC Board ETI423
F1-F4 1 Amp Fuse and panel mounting holders
Cover for 2N3055 transistor
Insulation kit for 2N3055

CHASSIS AND MISCELLANEOUS

Complete decoder board as published in ETI March '74 page 72.
1 spacer ¼" long (plain)
4 spacers ½" long (plain)
2 knobs John Carr type TK196 or similar
2 2 way RCA sockets
2 two pin DIN sockets
Mains cord, grommet and clamp
2 way terminal block
Metal chassis to Fig. 13
2 small right angle brackets to hold power supply board
Wood box to Fig. 12
23/0076 wire
Shielded cable
Front panel to Fig. 14

AMPLIFIER

R1, 2 Resistor 10Ω ½W 5%
R3 " 4.7k ½W 5%

C1,5 Capacitor 10µF 16V electrolytic*
C2 " 47µF 16V electrolytic*
C3 " 0.22µF polyester
C4 " 47µF 10V electrolytic*
C6 " 10µF 25V electrolytic*

C7 " 47µF 50V electrolytic*
C8 " 0.1µF polyester
C9 " 1000µF 35V electrolytic*

* all electrolytics should be PC mounting type

IC1 Amplifier Module Sanken S1-1010Y

PC Board ETI 420A

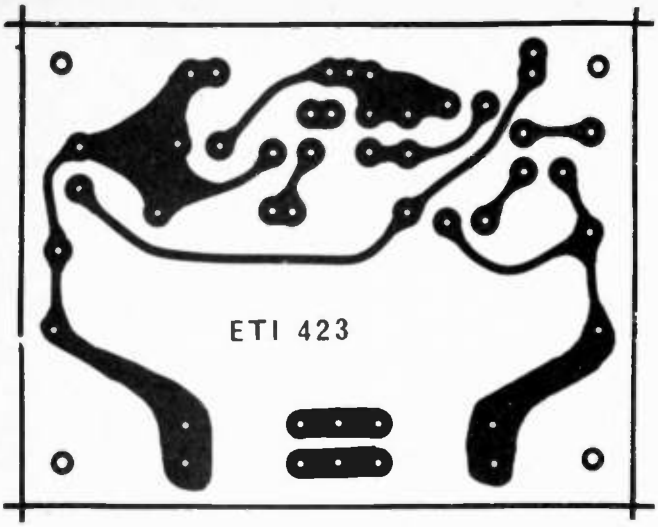


Fig. 6. Printed circuit board for the power supply.

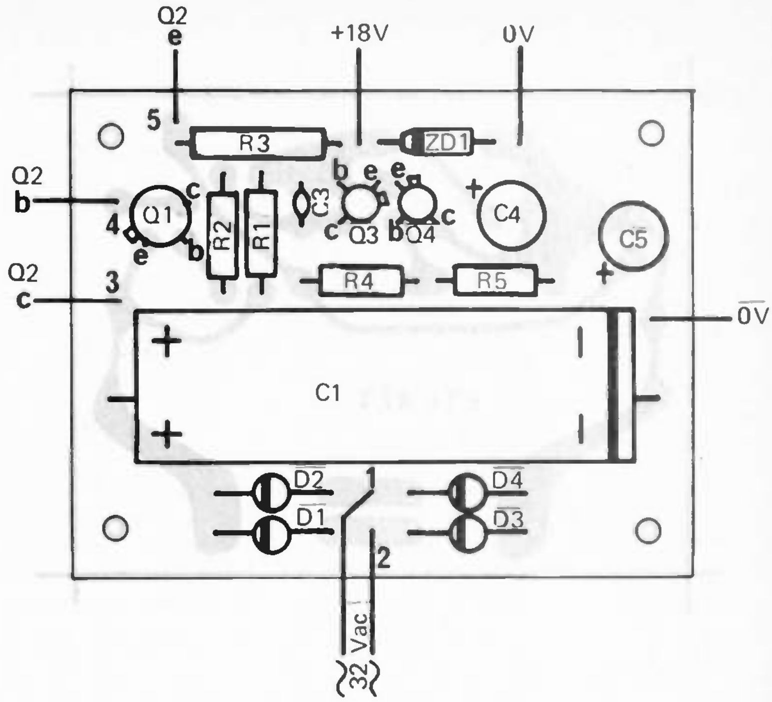


Fig. 7. Component overlay for power supply.

identical to that used in the International 420 four-channel amplifier (January 1974).

CONSTRUCTION

Components should be assembled onto the printed circuit boards with reference to the appropriate component overlays. Take particular care with the orientation of polarized components such as transistors, capacitors and diodes etc.

The interconnection wiring diagrams, Fig. 8 and Fig. 9, give details of the power and signal wiring respectively. The mounting positions of the printed circuits boards, transformer and potentiometers etc may readily be seen from the metalwork drawing and from the internal photograph of the unit.

The rear-channel amplifier may be omitted if a decoder unit *alone* is required. For this, the coaxial cables, that otherwise go to the power amplifier inputs, should now be connected to two additional RCA sockets on the amplifier rear panel.

Power requirements for the decoder board are negligible (0.36 watt compared with 30 watts for the complete unit). Thus a much smaller transformer and simpler power supply circuit may be used. A transformer having a secondary of 12.6 volts at 150 mA, a bridge rectifier, D1-D4, and a single smoothing capacitor, C1, is all that is required. The complete regulator section of the power supply may be omitted.

Although the existing printed circuit board could be used, by simply leaving off the unwanted components, it would be simpler and cheaper to use a tag strip to mount the components for this simpler supply.

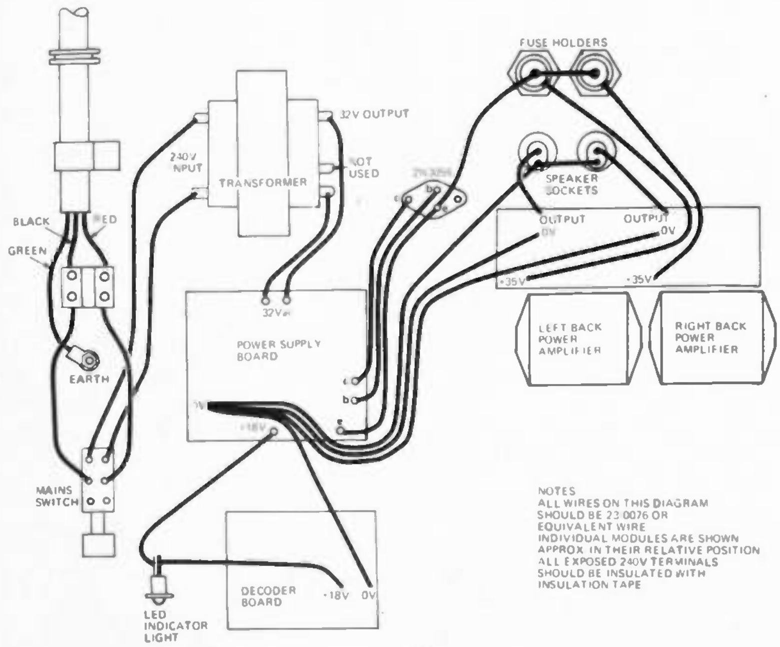


Fig. 8. Interconnections — power wiring.

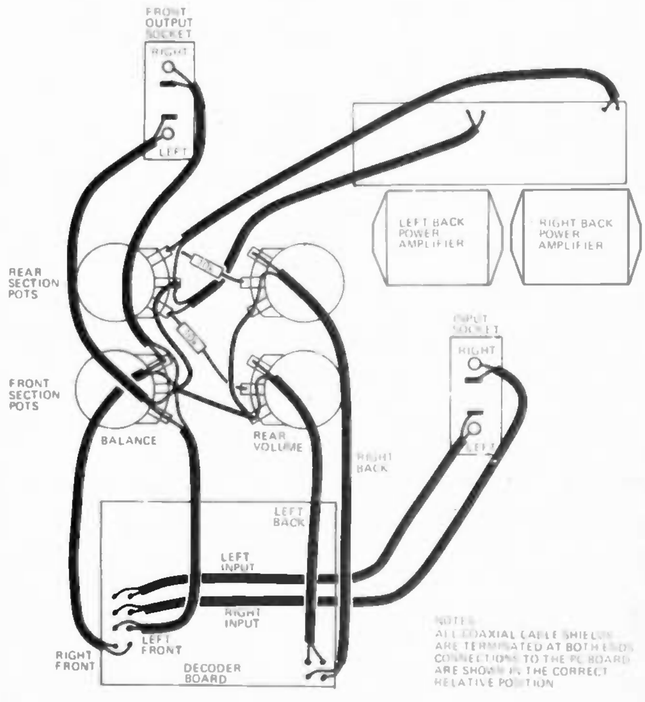


Fig. 9. Interconnections — signal wiring.

PLUS TWO add~on decoder amplifier

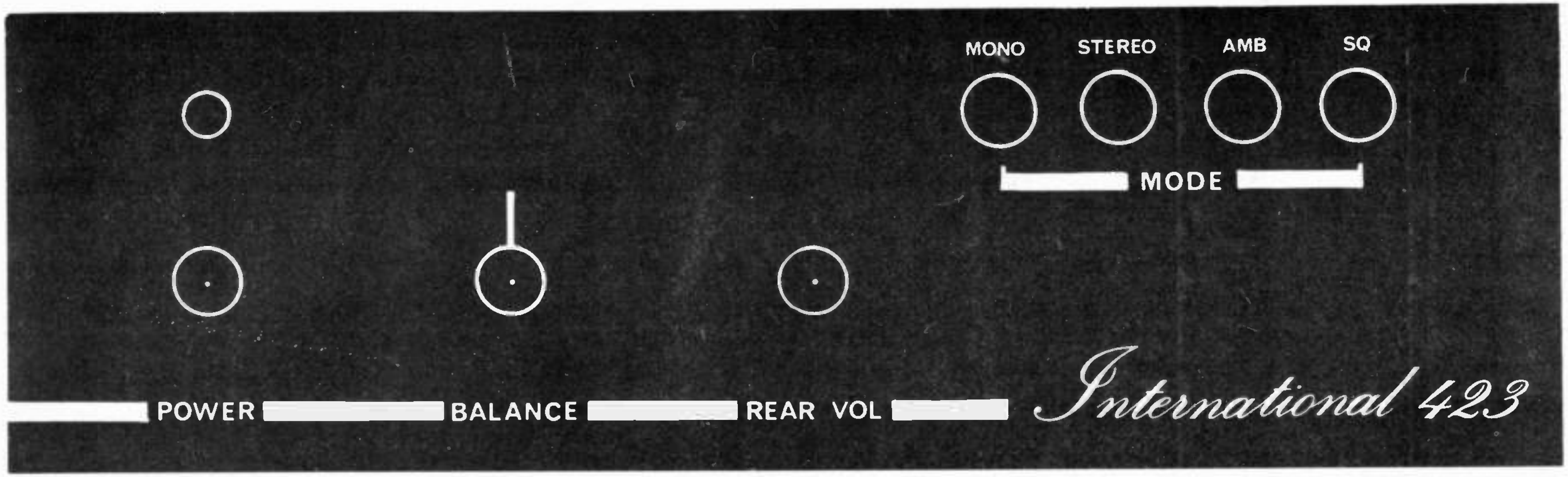


Fig. 10. Front panel artwork.

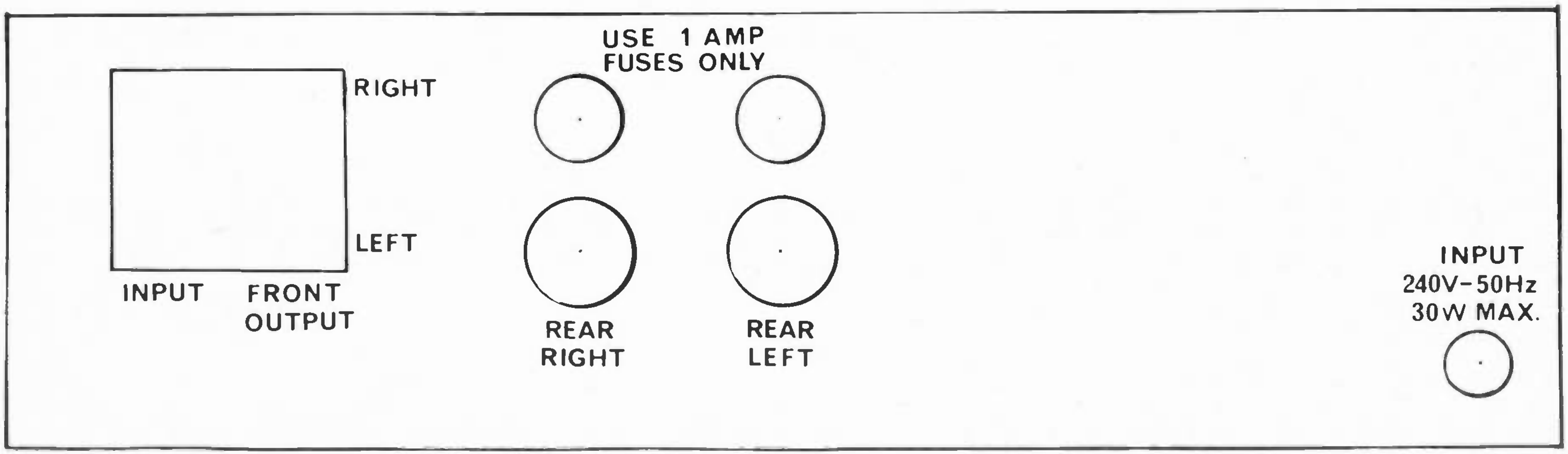


Fig. 11. Rear panel artwork.

PLUS TWO add-on decoder amplifier

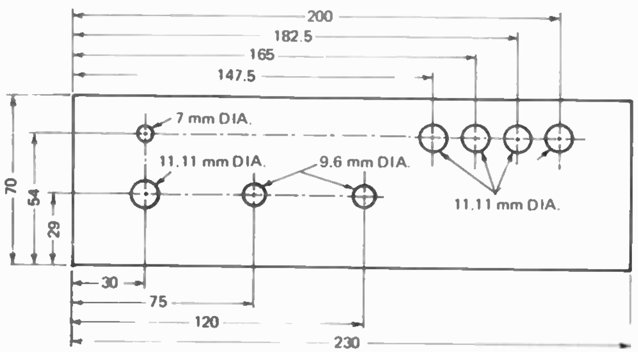


Fig. 14. Front panel escutcheon dimensions and drilling details.

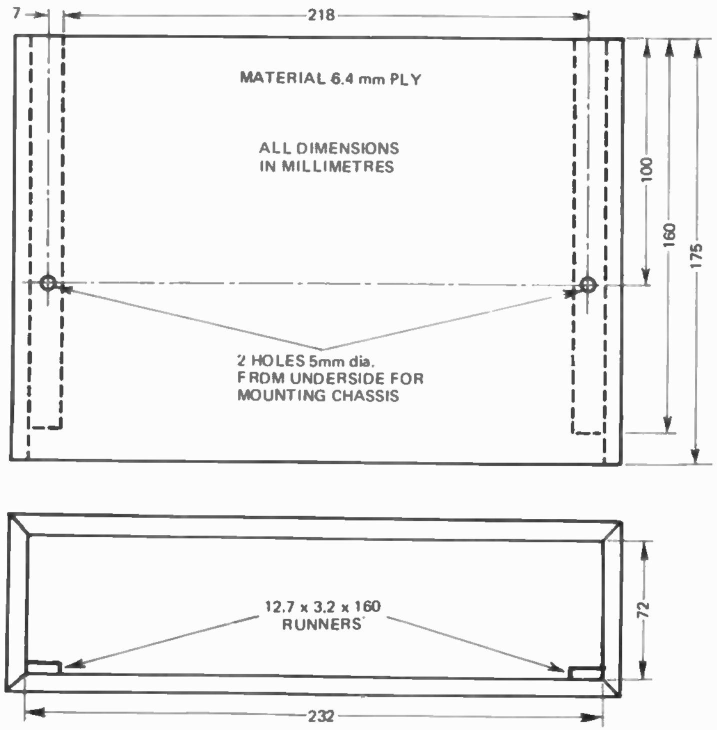


Fig. 12. Details of wooden cabinet.

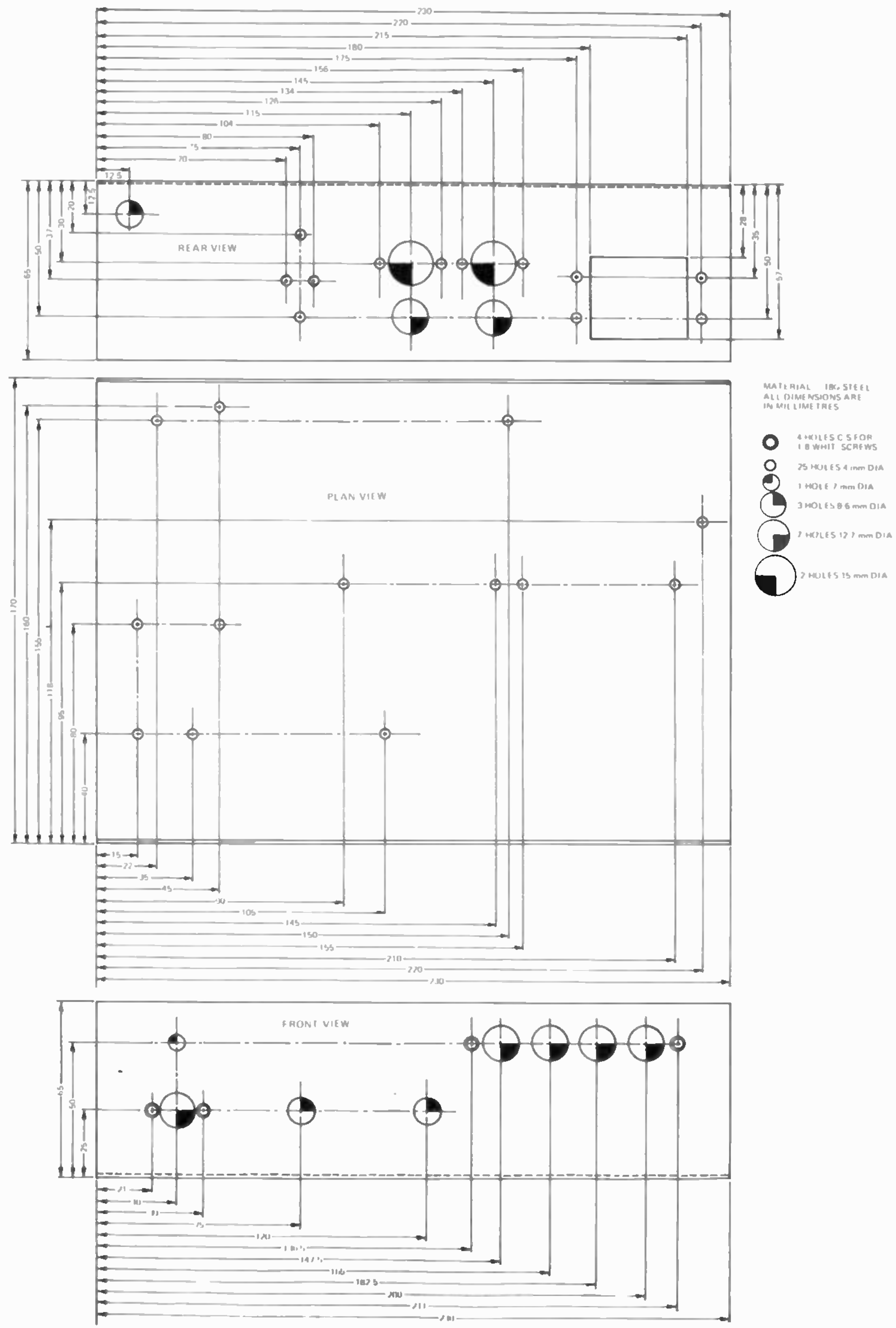


Fig. 13. Details of chassis metalwork.

for superb 4 channel reproduction

go for GRACE

*** Stereo Elliptical * Matrix 4 channel * 4 channel discrete**

After producing superb cartridges for 20 years, Grace, in conjunction with NHK (Government sponsored Broadcasting Institute of Japan) continued its search for an even better cartridge. This resulted in the F8L, then the Broadcast Standard Sigma 709 was developed from the commercial broadcasting field. From this came the F8C for critical hi-fi enthusiasts, and now comes the F8F Shibata 4 channel.

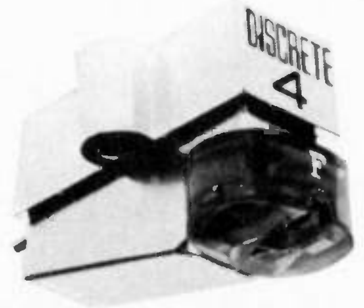
The ***GRACE*** *range includes:*

F8C Employs the well-proven Luminal Trace stylus, and tapered magnets ensure a flat response throughout the entire scale. Frequency range 15 — 25,000 Hz ±2dB −1dB

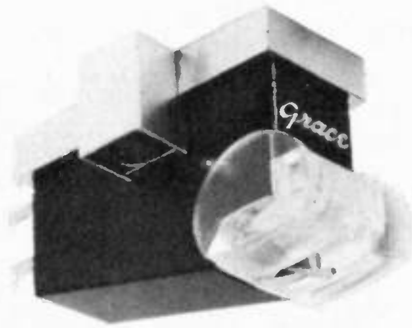
F8L Flat response, distortion-free performance, lifelike tonal reproduction, ideally suited to laboratory testing of audio equipment or records. Luminal Trace stylus, frequency 20 — 20,000 Hz±2dB.

NEW! G707 'QUADMASTER' 4 CHANNEL TONEARM

Ultra light weight, semi-integrated. When used with 4-channel stereo or high compliance cartridge, gives the superb reproduction available only from an integrated pickup. The fixed Lowmass head shell allows undistorted mid-frequencies tracking. Micro pivot Gimbal bearings reduce friction resistance to less than 20 milligrams.



CANADIAN STEREO GUIDE *said about Grace: "all in all, a very fine cartridge that deserves a place among the top performers".*



F8F MATRICAL FLUX 4 CHANNEL CARTRIDGE

Specially developed for reproducing Discrete 4 channel records. A wide range cartridge with Shibata stylus. Lightweight materials reduce cantilever mass to about half of other cartridges for improved frequency response, reduced mechanical impedance, high compliance. Minimal wear on stylus and record. Frequency 10 — 50 kHz. Also available as F8E for Matrix 4 channel and regular 2 channel stereo with luminal trace elliptical stylus.

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S.A. Challenge Hi-Fi Stereo, 6 Gays Arcade, Adelaide 5000. Telephone: 223 3599

TAS. Audio Services, 72 Wilson St., Burnie 7320. Telephone: 31 2300

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need we say more?

Proof indeed of the quality of the Luxman SQ 700X comes from F. C. Judd, writing in the authoritative British "Audio Magazine" March 1973:

> *"The makers tend to under-rate the performance of this amplifier. Rated twenty watts (sine wave) power per channel, the tested amplifier yieded over 25 watts per channel BOTH DRIVEN. I estimate the SQ 700XG to be a top performance amplifier."*

(Complete review on request.)

Briefly: 27 transistors, 2 silicone varisters, 4 silicone diodes. Frequency response 10-50,000 Hz ± 1dB. Distortion less than 0.1%. Other "ultimate fidelity" amplifiers built by Lux, the world's most experienced amplifier manufacturers: SQ 505X, SQ 507X, SQ 202.

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The two articles on surround sound that we published last month created exceptional reader interest. In this article, Professor Peter Fellgett explains his views on ambisonic sound. Peter Fellgett, C. Eng., F.I.E.E. is professor of cybernetics and instrument physics at the Department of Applied Physical Sciences, University of Reading.

AMBISONIC REPRODUCTION OF SOUND

ON THE 30th August 1973, as part of the Sir Henry Wood Promenade Concerts, a performance was given of Monteverdi's 'Vespers of the Blessed Virgin' to a capacity audience in Westminster Cathedral, and broadcast in stereo.

No one who listened to the broadcast heard what the composer intended!

This statement is in no way a criticism of the performance, which was of a very high standard, but of the limitations of stereo.

There is currently the possibility of removing these limitations by the development of systems of ambisonic reproduction of sound, preferably (but not necessarily) using additional audio channels. There is also the danger that this opportunity will be lost through a preoccupation with so-called 'quadraphonics', and it would be a tragedy if this came to pass. As we shall see, had the broadcast been 'quadraphonic' it could have reproduced only the most superficial aspects of Monteverdi's spatial intentions.

Monteverdi is to some extent a special case, because he belonged to the 17th-century school of St. Mark's, Venice, which laid great emphasis on spatial content in music, and may be regarded in this sense as the culmination of the antiphonal tradition of Gregorian chant. Later classical and romantic composers of orchestral music paid, however, little direct attention to spatial qualities, and the layout of an orchestra has apparently become mainly a matter of practical convenience. Wagner, in particular, liked his complex orchestral polyphony to sound as blended whole without any strong directionality.

Still more recently, however, there has been a return to explicit attention to the spatial content of music. Even apart from the somewhat extreme forms adopted by Stockhausen, Stravinsky loved directional effects and believed that stereo could provide what was necessary. He was, however, over-optimistic, since evidently stereo can distribute sound images (and these of a somewhat artificial kind) only along the line joining the two loudspeakers, whereas at an original performance direct or reverberant sound is heard from all directions.

'Quadraphonics', which anyway ought to be called tetraphonics if it is called anything, seeks only to distribute acoustic images (having the artificiality of stereo) along the four sides of a horizontal square surrounding the listener.

Ambisonic reproduction, on the contrary, seeks to surround the listener with direct or reverberant sound coming from all directions, and mimicking as closely as possible the sound field of the original performance. Systems which do this both horizontally and in height are called periphonic. If cost or other restraints make it necessary to consider only the horizontal direction, the system is called pantophonic (from the same root which gives us 'pan-potting'). These terms do not as yet enjoy wide currency, but at least seem a sensible choice to be going on with.

Spatial effects

It is pertinent to ask whether this emphasis on directionality and ambience is really worthwhile, especially in view of the neglect of explicit spatial relations in much of the music that is heard. Certainly most of the recording companies' 'quadraphonic' discs seem to have found little better to do with such directionality as they exhibit than to place the listener in the middle of the orchestra, where he would not wish to sit during a live performance anyway. A little reflection shows, however, that spatial effects permeate almost all our music. Orchestral composers may have paid little or no conscious attention to directionality, but the layout of an orchestra was part of their

subconscious experience, and part of the creative cybernetics of composition guided by knowing how an orchestra sounds.

Spatial relations are even more obvious in relation to church music, where reverberation is an essential part of the music, and moreover the composer will understand the spatial relationships between the choir and the different departments of the organ. This becomes explicit in organs designed on the work principle *(Werkprinzip)*, where a separate case for each department served to emphasise directionality and the contrast between choruses which adds much to the music of J. S. Bach and his contemporaries.[1]

All this is a very long way from stereo, in which acoustic images are pan-potted along the front wall of the listening room, or its 'quadraphonic' extension to 'surround stereo', in which these images are distributed along the other three walls as well. Such stereo images are in any case artificial,[2] and produce what several authors have described as a 'cardboard-cutout' orchestra. The intrepretation of such images apparently has to be learnt, and it is now known that an appreciable fraction of the population fails to do this. Moreover, we do not go to a concert to play a game of 'hunt the cymbal'. We do not care precisely where the woodwind and timpani have been placed, and certainly do not locate them in the 'right' places until our hearing perception has locked in to the visual clues, as any concertgoer can easily verify. On the contrary, what is essential is that each voice in the music should be labelled with its own version of the ambience of the place where the performance is taking place. Ambisonic reproduction can provide this, and the resulting realism has been graphically described by Gerzon.[3]

Essential requirements

Gerzon has elsewhere[4] emphasised how unnatural even the best recorded stereo sound is, compared with the splendour and subtlety of live music, and has listed seven essential requirements for realistic reproduction, all of which are absent from conventional stereo and 4-channel 'surround stereo'.

(1) the sense of fullness or richness given by reverberation coming from all around one.
(2) the sense of distance between the performers and the listener.
(3) sound coming from all round the listener, including the small noises from the audience which are part of the subconscious atmosphere of a performance.
(4) the ability to hear closely spaced sounds as clearly separated spatially.
(5) a sense of height, necessary for realistic ambience and especially relevant to sound sources disposed in height (like an organ).
(6) wide apparent dynamic range, which subjectively is not merely a matter of amplifier and loudspeaker power capability.
(7) awareness of the shape and size of the concert hall.

Each member of this list could usefully be discussed at length, but item 4 in particular calls for comment because it may appear superficially surprising, since sense of direction is supposed to be what stereo is all about anyhow. Indeed, stereo blending can provide quite accurate location of single sound sources along the line joining the loudspeakers, but the real question concerns the ability to distinguish spatially neighbouring voices in the blend of orchestral or other sound. Here it is necessary to distinguish between the multimicrophone pan-potted type of recording, in which this ability is poor but can be partially replaced by an 'analytical' quality owing little to original spatial relationships, and by contrast recordings made with simple Blumlein-like microphone techniques. In skilful hands, these latter can give discrimination of quite a different order, involving both directionality as such and also labelling with spatially related ambience. A large part of the reason is that such 'stereo' happens to provide more than was consciously intended, and, subject to an ambiguity difficulty, is a pantophonic system in its own right.[5]

Artificial conditions

Ambience and directionality are so inextricably inter-twined that it is hardly meaningful to talk about them separately. Quite simple experiments soon convince one that most of the reported work on sound locations has either been under conditions too artificial to be relevant to music listening, or has been vitiated by unintended clues such as constancy of amplitude and quality of the test sound. Even the effect of blocking one or both ears is not as predicted, as the author verified in a zero-cost investigation under effectively anechoic conditions obtained by standing blindfold on the summit of Brea Hill, Trebetherick, and being stalked by his young daughter, who excellently fulfilled the instruction to randomise direction, distance and loudness. (That casual observers entertained doubts as to the author's sanity is beside the point.)

Front-back discrimination in particular is subtle and often unreliable; under normal conditions it certainly involves ambience, and performance in all directions apparently depends on the extent to which the ambience of the listening room has previously been learnt by the observer. 'Quadraphonic' surround stereo is incompatible with any practicable microphone technique capable of picking up true ambience, and accordingly is inherently limited even in its averred objective of providing simple directionality; there is, moreover, evidence that stereo blending does not work at all well except over the front sector relative to the observer. Ambience indeed is of the essence. If it were not so, why is it worthwhile, as it certainly is, to record a solo performance in stereo (for all its limitations)? Why is it thought worthwhile to spend many thousands of pounds creating concert halls with good acoustics?

The listener to high-quality reproduced sound, provided with a true periphonic signal (i.e. ambisonic, including height information), has the choice of reproducing it in full, or he may for reasons of cost or convenience wish to sacrifice the height information and listen pantophonically, sacrifice front-rear information and listen in a stereo-like manner, or even reduce the signal to monophonic. Even in the latter mode, it will probably sound better than pan-potted offerings because something at least of the ambience labelling will come through. A good system will need to be reasonably

AMBISONIC REPRODUCTION OF SOUND

compatible with all these modes of reproduction.

Periphonic coding

At the recording end, however, there is no such choice. With pan-potting, the stimulated direction of arrival is under direct control, and can be restricted in any desired manner, but if true ambience is to be recorded a microphone sensitive to direction of arrival must be used, and reverberant sound will impinge on this from all possible directions. Whether it was consciously intended or not, the microphone must therefore perform some kind of periphonic coding, including response in height. All ambisonic recording must therefore necessarily be periphonic, and ignoring this fact merely opens the door to the height information being encoded in some non-optimum manner.

Hitherto in this discussion, no mention has been made of the technological means of achieving ambisonic reproduction, and in particular the number of channels required. This omission has been deliberate, in as much as technology should be the servant (albeit the creative servant) of need. Many of the published discussions of channel number have been vitiated by confusion between the number of channels, the number of signal sources, and the number of loudspeakers.

Recording companies give the impression that the number of signal sources is four — namely, the four tracks of their master tapes — but in fact these will usually have been mixed down from perhaps 32 tracks, and probably even more microphones and still more performers. The number of loudspeakers is usually assumed to be four, mainly because most rooms have four corners, but there is no particular magic about this number. At a pinch, one could surround the listener in the horizontal plane with only three speakers, although it is not really advisable. Three decoder outlets feeding two separate front speakers and two parallel rear speakers (one possibly phase-reversed) would be much better, probably substantially equal to four separate speakers as used 'quadraphonically'. Six speakers in the horizontal plane would definitely be advantageous if one could afford them, and eight would be a luxury.

Four loudspeakers is the minimum number that can enclose the listener in three dimensions, and Gerzon[3,4] has shown that this number of loudspeakers in skew-tetrahedral array can be extremely successful. For real periphonic luxury, eight speakers could be disposed in cubic array surrounding the listener. These examples show that there is no necessary equality between any or all of the number of decoded outputs or the number of loudspeakers. Historically, both mono and stereo have a one-to-one relationship between channels and loudspeakers, and this is probably why speaker and channel numbers continue to be confused. In fact, a minimum of two channels can evidently be decoded to give as many different (but not, of course, independent) outputs as we please.

Numbers of channels

For the benefit of our non-mathematical readers the next section may be abbreviated as follows:

It is possible with two amplifier channels and correct encoding of the signals, to provide complete 360° directional information in the horizontal plane without ambiguity.

If vertical as well as horizontal direction is required then four channels are capable of being encoded to provide this.

However such four-channel encoding would be a completely different concept from that used for present quadraphonic systems which convey information in the horizontal plane only — Brian Chapman, Technical Editor.

How many channels are in fact needed? Pantophonically, i.e. considering the horizontal plane only, existing microphone technology provides omnidirectional, figure-of-eight, cardioid and supercardioid directional responses. If the azimuth angle is denoted by θ and the omnidirection signal is normalised to unity, all these responses are composed solely of linear combinations of the terms 1, $\cos\theta$ and $\sin\theta$ with very little contribution from higher circular harmonics. The three signals representing these terms can evidently be completely transmitted using just three channels. However, with some compromises, it is possible to be rather more cunning than this. If two channels transmit the signals $\cos\theta$ and $\sin\theta$, the unity signal is implicitly available as $\sqrt{(\cos^2\theta + \sin^2\theta)}$. This is essentially what the Blumlein coincident stereo microphone provides.[6] It has a 180° ambiguity since, in the absence of a separate omnidirectional channel to provide a reference of phase, it is possible to distinguish only whether $\sin\theta$ and $\cos\theta$ have the same or opposite signs.

In modern pantophonic systems using amplitude encoding, this ambiguity is overcome essentially by making the two signals proportional to $\sin(\theta/2)$ and $\cos(\theta/2)$. An alternative method is to make the amplitude characteristic of each channel omnidirectional, but to encode direction as the phase difference between the now equal signals in the two channels. Usually this phase difference is simply made equal to the azimuth angle θ, and the system may be regarded equivalently as encoding the two channels so as to yield $\cos\theta + j\sin\theta$; such arrangements are referred to as phasor systems.

Directing attention to periphonic recordings, as we have seen to be logically necessary, requires that, instead of circular harmonics, spherical harmonics have to be considered. It is now convenient to express the directional characteristic in terms of the direction cosines x, y and z corresponding to three cartesian axes. Any combination of effectively coincident microphones of current design, pointing in any direction and with any combination of omnidirectional, figure-of-eight and cardioid or hypercardioid responses, gives only linear combinations of the zero- and first-order spherical harmonics 1, x, y and z. The corresponding signals can therefore be completely carried by four audio channels. This is the one genuine sense in which four is a significant number in this subject, and it will be understood that this significance is quite distinct from anything in 'quadraphonics' as currently presented.

2-channel encoding

Is it possible to reduce this number by similar cunning to that employed in the pantophonic case? This is indeed possible, and the number of channels can be reduced, subject to some compromises, successively to three and even to two. One penalty is that both amplitude and phase must be used in the encoding, and the use of phase is a nuisance because it gives rise to phasing difficulties between the loudspeakers the system eventually feeds. Explicitly, a 2-channel periphonic encoding is possible by coding azimuth using amplitude as previously described, and combining this with a phasor coding for vertical angle. Such 2-channel systems (and remember that periphonic encoding will take place whether it was deliberately intended or not) are best analysed using the concept of the energy sphere.[7]

Knowing the number of channels necessary, it is now meaningful to recall how many channels can be provided with each of the existing media in wide use. The conventional non-multiplexed vinyl disc is strictly 2-channel, even when it is sold as '4-channel' apparently contrary to the Trade Descriptions Act. The JVC multiplexed disc gives four genuine channels, but its robustness under domestic conditions has yet to be verified. F.M. stereo broadcasting gives, of course, two channels, but, since the stereo subcarrier is double-sideband-modulated, it has sufficient bandwidth for three channels. This capability could be realised either by single-sideband modulation or (equivalently) by a combination of phase and amplitude modulation. Since three channels are highly satisfactory pantophonically, and also have good periphonic capabilities, some very interesting possibilities are opened up for the future of f.m. broadcasting. Finally, magnetic tape can provide any number of channels at the expense of cost and signal/noise ratio.

The way forward for all these media lies in accurately stating and understanding the number of audio channels they provide, and in each case using this number in the best possible way; namely, periphonically and not in such suboptimal modes as surround stereo.

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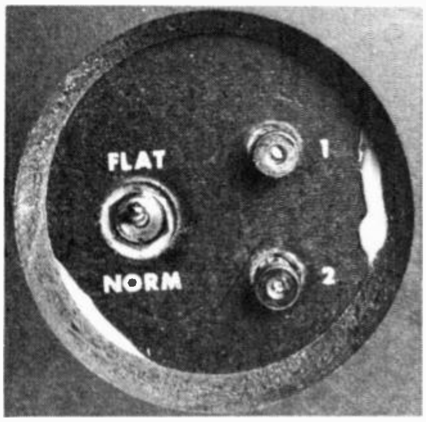
Recommended retail price
$189 per pair

ACOUSTIC RESEARCH AR-7 LOUDSPEAKER

AR's latest miniature speakers have exceptionally good performance for their price.



ACOUSTIC RESEARCH have built up an enviable reputation over many years. Their loudspeakers are known world-wide for their true fidelity and lack of colouration.

We reviewed the AR-6 speaker in February 1972, and felt then – as in fact we still do – that here was one of the few bookshelf speakers that could provide a compromise-free performance comparable with more conventionally sized units.

The new AR-7 is the smallest and by far the cheapest speaker made by Acoustic Research. It is so small that when we picked up the box of the AR-7 without having seen the contents, we asked where the other box was – and were told that both speakers were in one carton. (Actual dimensions are 248 x 400 x 159 mm).

As with other AR speakers, the AR-7 enclosures are well made and very rigid. The veneer is not of the same standard as that used on other AR enclosures, the grille cloth, however, appears to be AR's standard material.

Two drive units are used – a new 200 mm (nominally 8") acoustically suspended bass unit, and a 38 mm cone tweeter similar to that used in the AR-6.

A 'flat/normal' two-way switch is located at the rear of the enclosure.

When assessing hi-fi equipment we normally compare units with others of the same type and approximate price — and to some extent with other units from the manufacturer's range.

The AR-7s presented us with rather a problem, for there are few speakers with any worthwhile performance, hence comparisons on a price basis are virtually impossible to make.

HOW THEY SOUNDED

Likewise it is difficult to relate the AR-7s to other AR speakers, for unlike AR's other products some performance compromises have obviously been made in order to obtain small overall size and a very low selling price. Bass response for example is not as extended as that from the excellent, but of course, more expensive AR-6.

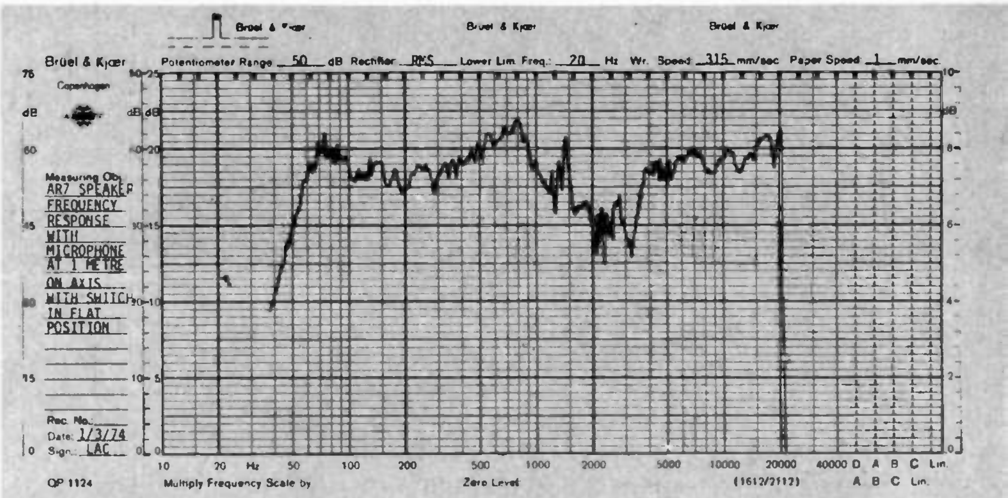
Overall response is not subjectively flat, and as we subsequently saw, drops significantly in the region of the crossover range between woofer and tweeter.

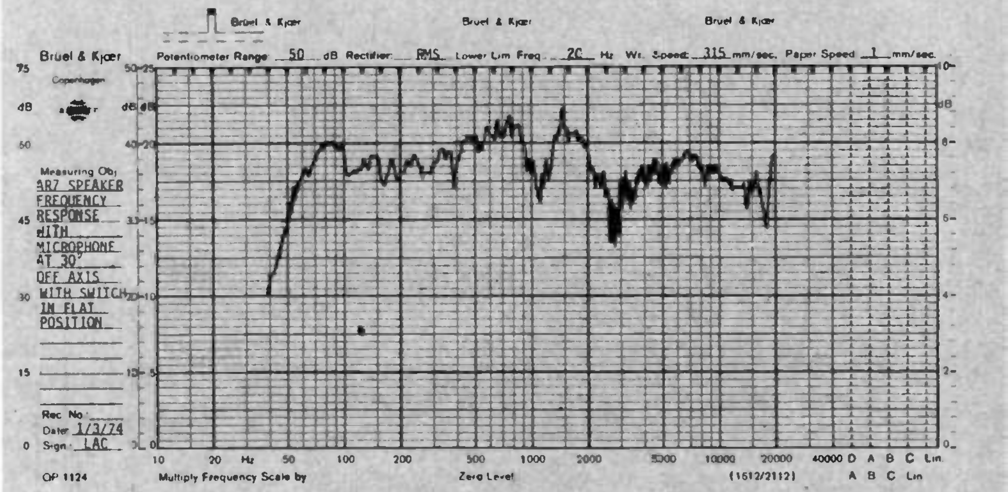
The measured response at least of the unit tested, was not as flat as the data sheets indicated. The tweeter is relatively flat, but the acoustically-suspended woofer is rather non-linear.

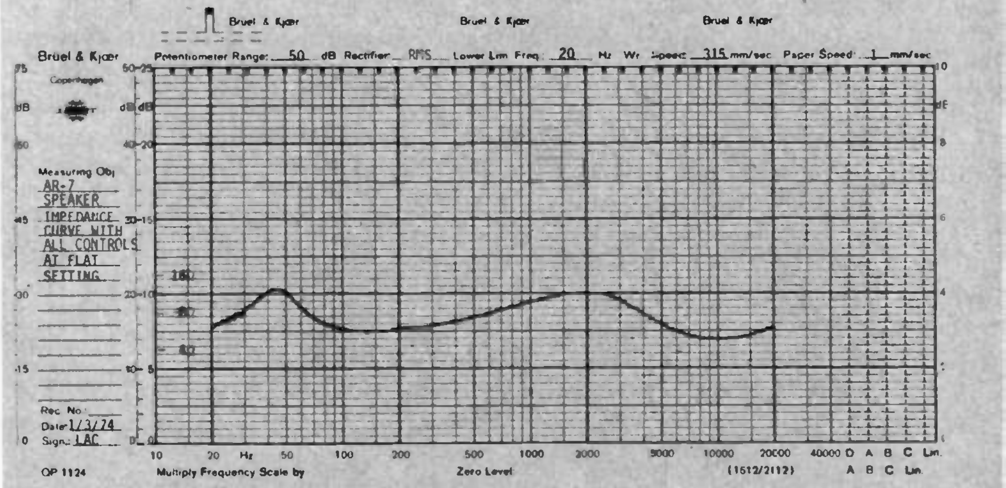
As with the AR-6, the high frequency dispersion is particularly good — in fact exceptionally so if the very low price is taken into account.

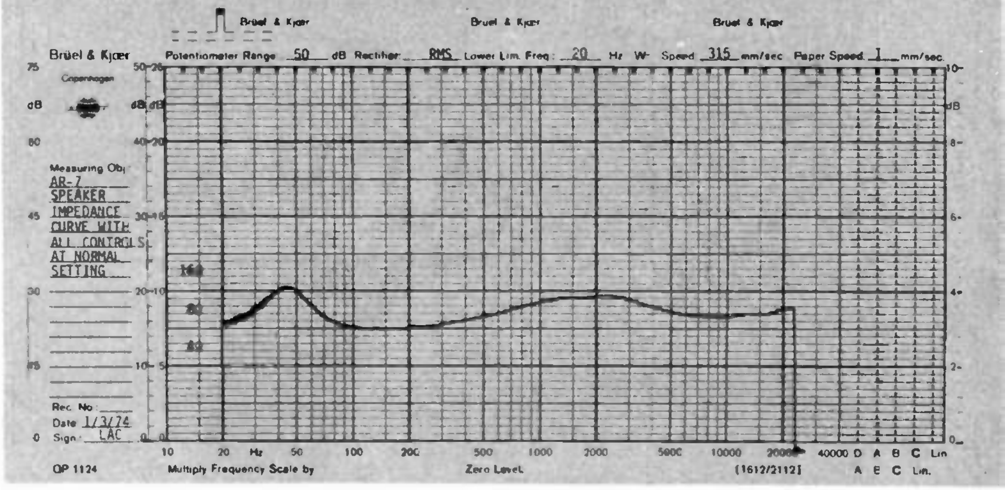
The manufacturers claim that these speakers can be driven with amplifiers of up to 100 watts per channel. Certainly our tests with a twin 80 watt amplifier at maximum output showed this statement to be reasonably true — if one is prepared to ignore the high level of distortion that occurs at such high levels. Even so the power handling capacity of the speaker is good.

Acoustic Research do not provide any details of the crossover system but by looking at the price and the measured frequency response it is clear that the crossover network is particularly simple and most probably consists of a simple capacitor crossover network. There is measurable interaction between the woofer and tweeter of 1500 and 3000 Hz. This interaction results in audible colouration which is not typical of other AR speakers, and which we found to be particularly apparent using the AR Demonstration Record.









ACOUSTIC RESEARCH AR·7 LOUDSPEAKER

The overall distortion characteristic of this speaker is good above 100 Hz. Distortion is audible as frequency doubling or second harmonic distortion below 100 Hz, but only at moderately high power levels. Below 20 watts we could detect no audible distortion at all.

The impedance characteristics are particularly smooth – in fact more so than any other system that we can recollect testing.

Maximum impedance occurs at the resonance frequency of 45 Hz and there is no great difference between the shape of the curves with the switch in either the flat or normal position.

The AR-7s may well be exactly what a substantial number of people are seeking.

They are not perfect – in fact there is quite noticeable colouration, concessions have to be made when one designs a speaker of this size and/or price.

But *for* their size and price, the AR-7s offer exceptional value for money. ●

MEASURED PERFORMANCE OF AR-7 SPEAKER SERIAL NO: 03402

Total Harmonic Distortion (for 90 dB at 2 metres on axis)		
	50 Hz	6%
	100 Hz	0.9%
	1 kHz	0.45%
	6.3 kHz	0.2%
Electro-Acoustic Efficiency (for 90 db at 2 metres on axis)		12.4 watts
Measured Impedance		
	100 Hz	6 ohms
	1 kHz	9 ohms
	6.3 kHz	5.5 ohms
Speaker Resonance	45 Hz with 12 ohm impedance.	
Cross-over Frequency	2.6 kHz	
Weight	4.7 kg	
Dimensions	400 x 248 x 159 mm.	

TEL-26 DYNAMIC $36.95

TEL-14/TWO-WAY
$29.95

TEL-29/LIGHTWEIGHT $19.95

TEL-111/ELECTRET $85.00

TEL-32Q/QUAD,
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The TEL-26 DYNAMIC Stereo Headphone reproduces sound so faithfully that once you hear it, you'll never be satisfied with anything less. It has a separate tone control and volume control on each earcup to permit precise volume, balance and tone adjustments. And Telephonics mechanical 2-way speaker system gives you the 2-way sound without the cost.

For the breathtaking realism of quadraphonic sound, the TEL-32Q QUAD, 4-CHANNEL Headphone has two 2-way speaker systems (four speakers in each earcup) to let you discover sound you've never heard before. The Telephonics Balance Controller lets you sit in your favorite easy chair, far from your receiver or amplifier, and set the 4-channel balance exactly the way you want it.

The TEL-14 TWO-WAY Headphone contains a full 2-way speaker system, complete with crossover network in each earcup. Deep, smooth bass response from the woofers and the bright treble highlights of the tweeters overlap to make the presence of the music felt, just the way the artist intended.

The TEL-29 LIGHTWEIGHT Headphone, the "Weight Watcher" member of the family is easy on the budget. Constructed of air-light materials for hours of easy listening, the Lightweight never disturbs nor intrudes on the music, but is not completely isolating. A volume control on each earcup allows you to adjust volume and balance without returning to your amplifier.

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BOOK REVIEWS

REVIEWER: Brian Chapman

BEGINNER'S GUIDE TO COLOUR TELEVISION. By Gordon J. King.
Published by Newnes-Butterworths 1973. Hard covers, 189 pages 185 x 125 mm. Price $5.75.

Colour television is now just around the corner for Australia and many technicians, engineers and other people desiring an insight into colour techniques will welcome this little book on the subject.

Although the UK system is slightly different from that proposed for Australia (UK system operates in UHF bands, has different bandwidths and some other slight differences), it is a PAL system, and in the main therefore books written on the UK system will be of value to us here in Australia.

This is in contrast to books written in the USA that only cover the NTSC 525 line system in use there, and hence, are of little value here.

The book under review is written by one of the best known UK authors of basic electronic texts. The style is clear and unambiguous and, although primarily designed for the beginner, the book contains all essential information on the PAL colour system. Thus an engineer in another field of electronics would be satisfied with the book as a means of obtaining background knowledge on colour television.

Many charts, diagrams and drawings are provided. These are of high standard. Many of them show much originality and would provide the reader with considerable insight into the processes involved in colour television.

Truly an excellent book for the beginner. -- B.C.

HOW TO BUILD SOLID-STATE AUDIO CIRCUITS.
By Mannie Horowitz.
Published by TAB books 1972. Soft Covers, 320 pages 140 x 215 mm. Price $7.40.

Many thousands of people are interested in electronics and like to experiment with circuits and build projects etc. However there is infinitely greater satisfaction for the experimenter in designing, as well as building, his own circuit but, unfortunately, very few have the ability to do such design rather than follow, slavishly, someone else's circuitry.

In all electronic design however, there is no 'instant-way' of gaining the necessary expertise. Even in such a narrow field as audio amplifiers it is impossible to read a short article and therefrom, be efficient in audio design. It requires a very large book to cover the field adequately. And even then it is not just a matter of skimming through such a book. One must study at length each step in the process, perform all calculations and apply the method to sample design problems. Then practice, practice and more practice to gain proficiency.

This book provides the first step, a basic guide to the practical, step-by-step design of solid-state audio amplifiers. You must provide the effort. It is eminently suited to the experimenter as the usual heavy going of device physics has been left to other texts. Additionally, practical tolerances have been considered in reducing the design equations to their simplest useful form such that a knowledge of basic algebra is all that is required to follow the design procedure.

Perhaps not rigorous enough for a practising design engineer but, as said before, an ideal book for the experimenter. – B.C.

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 rated 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

7400 SERIES TTL — DIP

7400	Quad 2-input NAND gate	$ .20
7401	Quad 2-input NAND gate	.20
7402	Quad 2-input NOR gate	.22
7404	Hex inverter	.22
7405	Hex inverter*	.20
7406	Hex inverter buffer/driver*	.35
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7410	Triple 3-input NAND gate	.20
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7430	8-Input NAND gate	.20
7440	Dual 4-input NAND buffer	.20
7441	BCD-to-decimal decoder/driver	.80
7442	BCD-to-decimal decoder	.80
7447	BCD-to-7 segment decoder/driver	1.00
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7451	Expandable dual 2-wide 2-input AND-OR-invert gate	.20
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74123	Dual retriggerable monostable multivibrators with clear	1.50
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CA3018	2 Isolated transistors and a Darlington-connected transistor pair	.75
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LM3900	Quad op amp	2.00
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8093-8094	Tri-state quad buffer DIP	$1.00
8850-9601	One-shot multivibrator DIP	1.50
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RTL EXPERIMENTER PACKAGE

We purchased a computer using RTL logic. All the ICs are Motorola plastic DIP 700 series. Each board contains 3 or 5 ICs and a gold-plated standard 42-pin finger connector. VCC and ground are connected to all ICs, and a .05 bypass is provided. Each active pin of all ICs on the board go to a pin on the connector.

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#4	3 MC792P	Triple 3-input gate	1.25
#5	5 MC799P	Dual buffer	1.25

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Bank of 5 bussed together to take 5 boards - gold-plated wire $2.50

Ten bussed together $4.50

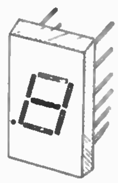
Set of 5 boards and sockets with data and applications $7.95

LSI CALCULATOR ON A CHIP

This 40-pin DIP device contains a complete 12-digit calculator. Adds, subtracts, multiplies, and divides. 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 $7.00
Data only $1.00

SLA-1 OPCOA



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100 Ohm	10K	250K
200 Ohm	20K	500K
500 Ohm	25K	1 Meg

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Please specify P or L (PCB or wire leads). Order NOW, these won't last!

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).

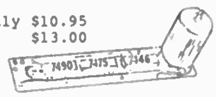
A 7490 decade counter IC is used to give typical count rates of up to thirty MHz. A 7475 is used to store the BCD information during the counting period to ensure a non-blinking display. Stored BCD data from the 7475 is decoded using a 7447 seven-segment decoder driver. The 7447 accomplishes blanking 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 4 3/8" 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

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 $4.00

SPECIAL 5 for $17.50

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

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 worse case TTL requirement) at current of up to one ampere.

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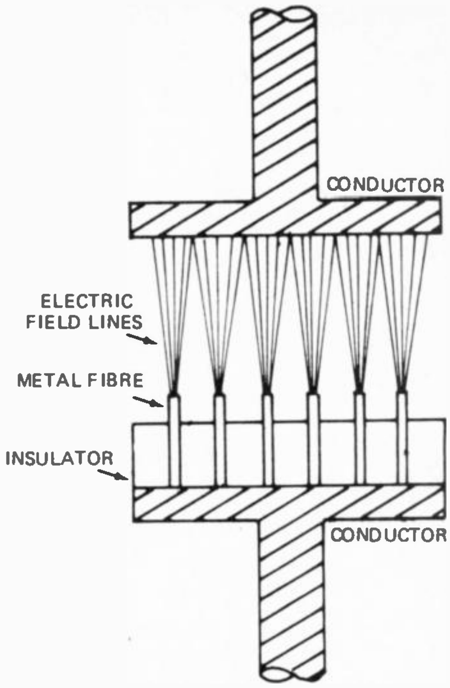
Post Office Box J, Carmichael, California. 95 608 U.S.A.

This article has been based on information supplied to us by Joe Shelton, Jerry W. Hagood and Ralph L. Norman of the US Army Missile Command, Redstone Arsenal, and A. T. Chapman of the Georgia Institute of Technology, Atlanta, Georgia, USA.

ELECTRONS FROM COLD EMITTERS

Will this new technique revive valve technology?



EFFECT EMISSION ELECTRONS ARE DRAWN FROM THE METAL FIBRES BY THE ELECTRIC FIELD FORCE

IN 1904, Alexander Fleming patented a device known as the Fleming electric valve. This valve contained two elements, a filament that, when heated, emitted electrons — and a plate called an anode.

Later in 1906, de Forest added a third element. This element, known as the grid, was an open weave screen placed between the filament and the anode. An electric charge placed on this grid controlled the flow of electrons in the space between the emitter and the anode.

Such valves formed the basis of all radio and 'electronic' equipment until the advent of the transistor in 1948.

Even now, despite the commercial acceptance of solid-state technology, valves are still used in many applications from home TV sets to high-power transmitters.

In fact a recent survey showed that the total value of valve sales has increased steadily despite semiconductor and IC technology.

Valves fill applications where combinations of bandwidth, high-frequency of operation and power capability cannot be met by present semiconductor techniques as economically, if at all.

Typical of such valves would be the klystron, the travelling wave tube and high power transmitter output valves.

HEATED FILAMENTS

Since valves obtain the electrons required for their operation from some material which gives off electrons when heated, this material is either formed directly *into* a filament or is indirectly heated *by* a filament.

At first glance, the heated emitter appears satisfactory as a source of electrons for the valve. However, in actual devices there are many problems associated with heated electron emitters. The emitter heaters operate at high temperatures and are very inefficient. Most of the input energy is given off as heat instead of emitted electrons. The results are somewhat comparable to that of the incandescent light bulb where the input energy is mostly converted into heat instead of the required light.

Since the incandescent light bulb is filled with an inert gas, excess filament heat is rapidly carried away by convection; however, in valves elaborate emitter and/or filament cooling techniques are sometimes necessary, especially in higher-power applications.

The excess heat requires space to be provided for its dissipation, both within the valve and the equipment in which the valve is used.

This is a very serious limitation and because of this many attempts have been made to obtain electron emission from a cold substance.

COLD EMISSION

So far the most promising approach involves the use of a few million ultrafine metallic fibres, projecting from a conducting plate which serves as the source of the electrons in the circuit, The electrons are emitted from the metal fibres when a voltage source is connected (as shown in Fig. 1).

Experimentally, electrons have been emitted from single tungsten wires after appropriate pointing by chemical means. However, the area of the individual tip is very small, and consequently, the current per wire is also small (less than a microampere). Many millions of pins of fibres are required to provide the necessary electron current to make a useful device. Further, these fibres must be spaced so that a million or more are available per square centimetre of the emitting surface.

These minute fibres must be structurally stable under the stresses encountered in use, the high accelerative forces of a missile for instance, and under the electric field forces which are quite high. Electrically, each fibre must be conductive and continuous and a manufacturing process must be available to weld the fibres to the plate which is the source of the electrons. The final emitter must be designed such that all fibres project the same distance so as to subject each of them to the same electric field forces.

Ideally, one would like a material similar to that illustrated in Fig. 2. In this ideal material, in addition to the characteristics outlined above, each fibre is approximately the same distance from all its next nearest neighbours and each fibre is structurally supported by a high-resistance insulating material, perhaps a ceramic or glass of high strength.

The density of the fibres should be one million to a few million fibres per square centimetre surface area and the size of the individual fibres should be variable in a controllable manner. The overall matrix of fibres and the surrounding insulating material should be such as to enable its shaping by common manufacturing processes such as cutting, grinding, polishing, etc. Further, one could hope that the metallic fibres and the insulating material would differ sufficiently chemically to enable chemical processing as well as machine processing.

UNIQUE COMPOSITES

Recently materials with almost exactly these demanding requirements were developed under the technical direction of Dr. Chapman, School of Ceramic Engineering, Georgia Institute of Technology in the USA.

These materials are a unique class of composites, called oxide-metal composites, and contain many very small metallic fibres uniformly aligned in an insulating-ceramic matrix.

The composites are produced by radio-frequency induction-melting oxide-metal mixtures and using a technique called *unidirectional solidification.*

Early experimental results at Georgia and elsewhere indicate these new materials perform well. Currents of several 100 milliamperes per square centimetre have routinely been obtained Maximum currents of 0.5 amperes per square centimetre were drawn from this same emitter.

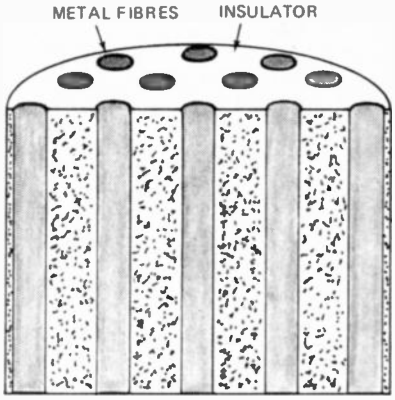
These results predict the appearance of a whole family of new valve devices. With the elimination of the emitter heater, circuitry and manufacturing complexity decrease. The total absence of the excess heat eliminates cooling equipment and allows device packaging in a smaller envelope.

This device has another characteristic not yet discussed which is extremely valuable in many electronic applications — it is truly "instant on". Several TV manufacturers advertise that their sets are "instant-on"; however, they achieve rapid activation of the set after it is turned on by keeping its valve emitter filaments activated to some 40 per cent normal power. This lower power level enables the emitters to produce electrons very rapidly after the set is turned on.

Since the new emitter operates at room temperature, it will give both picture and sound instantly. It will not require power during the time the set is not in use.

It is predicted that this new vacuum device will replace many present electronic valves, especially those utilized in high-power equipment, that its useful lifetime will be longer than the heated emitter valves and that it will result in an overall cost reduction for the consumer.

The research efforts were sponsored by the US Defence Advanced Research Projects Agency. ●



OXIDE-METAL COMPOSITE MATERIAL FOR FIELD EFFECT TRANSMISSION

EQUIPMENT

500 MHz FREQUENCY COUNTER

An ultra-small seven-plus-one digit automatic frequency counter has been developed by N.E.T. Nucleonics Electronics and Telecommunications Pty. Ltd.

Called the NET-C-500, the unit can measure frequencies from 5 Hz to 500 MHz, with automatic ranging and seven digit resolution.

The unit operates on either automatic or manual mode. Automatic mode provides direct measurement of average frequency of any input signal. The time gate is the period of time-base frequency which is automatically selected. The manual mode also provides direct measurement of the average frequency of an input signal. The gate time is one second. This increases the resolution up to eight digits, and is useful for the read-out of the last significant digits.

The unit weighs 3.5 lb (1.6 kg). It is 4.5 inches wide, 2 inches high and 8.5 inches long (11.4 cm wide, 5.2 cm high and 21.5 cm long). Input sensitivity is 10 mV to 25 V (rms).

It has a noise rejection of minus 80 dB over input sensitivity. The maximum input is 100 Vdc or 2 Vac (rms).

Power requirements are 240-230, 115 V ac; 50 or 60 Hz dc; 12 to 32 volts without adjustment on automatic switching. Optional extras available with the units include an attractive carrying case and rechargable dry cell batteries for outdoor applications.

Further details from: N.E.T. Nucleonics Electronics and Telecommunications Pty. Ltd., 92 Woodfield Boulevarde, Caringbah. N.S.W. 2229.

PORTABLE POTENTIOMETER

A new Portable Potentiometer is now available from Kent Instruments (Australia) Pty Ltd. This instrument, a new version of the PP320 Portable Potentiometer, is manufactured by Foster-Cambridge Limited, a company which is also a member of the George Kent Group.

Designed for accurate measurement of instruments and electrical sensing elements such as thermocouples and resistance thermometers, the PP320 has two calibrated dials – a main scale and an associated cold-junction scale. A mercury-in-glass thermometer is incorporated to give temperature measurement at the potentiometer terminals. The basic instrument can be switched to either of the two basic millivolt spans – 0 to 20 mV and 0 to 60 mV – each scale carrying both millivolt ranges together with complimentary thermocouple ranges.

news

A choice of three main scales is available, each offering a different combination of ranges. In addition, optional facilities – potential divider and potential divider plus resistance measurement – are available for specialized user requirements with the latest units.

In use, the cold-junction temperature or equivalent millivolt reading is set on the cold-junction scale. Direct readings can then be made from the main scale eliminating the need for tables (where a standard thermocouple is used) or arithmetical corrections.

The instrument can be used for calibration and resistance measurement. It provides signals both for calibrating electronic instruments with input impedance greater than 100 ohms and – from a low impedance circuit – for calibrating instruments that take current from the source. For resistance measurement the instrument generates a known current through the unknown resistance and measures the potential drop across the resistance. Further details: Kent Instruments (Australia) Pty Ltd., 70-78 Box Road, Caringbah, NSW 2229.

Timbre

breaks the Sound barrier...

P. O. Box 91, St. Leonards. Phone 922 3405

● ● ● ●

The Timbre A40 amplifier has been designed using discrete operational amplifiers to give low distortion, flat frequency response and easily controlled gain.

The tone controls are of the Baxandall type with the frequency determining elements in the feed back loop.

The power amplifier is a fully complementary output design using current drive to all stages after the basic two transistor gain section. This is achieved by use of a current source load for the class A driver transistor and boot strapped load into this class A driver. The class B output transistors run without standing current giving very good thermal stability.

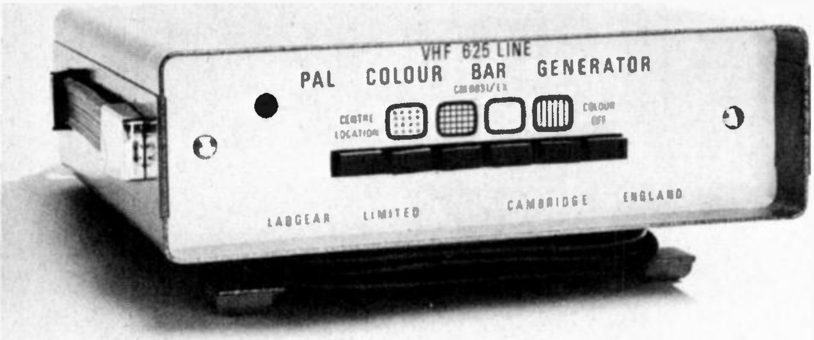
Attention has been paid to stability into reactive loads and, together with the very low distortion figures obtained gives a sound quality of exceptional standard.

Specifications

Power Output: R.M.S.	40 watts per channel into an 8 ohm load both channels driven.
Frequency Response:	20 Hz to 20 kHz ±1 dB.
Total Harmonic Distortion:–	Better than .1% (20 Hz to 20 kHz)
Intermodulation Distortion:–	Better than .1%
Hum & Noise:–	Phono 65 dB. Tape 65 dB. Tuner 80 dB. Aux 80 dB.
Sensitivity –	Phono 3mV. Tuner 200mV. Aux 1 200mV. Aux 2 500mV.
Scratch Filter:–	6 dB. at 12 kHz. 12 dB. at 20 kHz.
Tone Controls:–	Treble ± 15 dB at 10 kHz. Bass ± 15 dB. at 100 Hz.

EQUIPMENT NEWS

LOW COST COLOUR BAR GENERATOR



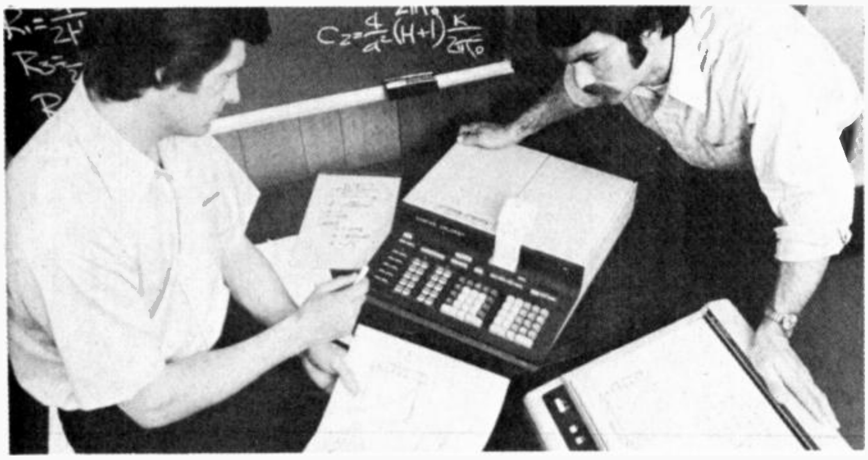
Tecnico Electronics are now stocking the Labgear Model CM6031/EX Colour Bar Generator.

This is a fully solid-state mains power instrument which generates the following test signal patterns: crosshatch, dots, also cross, dot for centre location; red raster – fully saturated red signal for PAL AB; blank raster – luminance component of red raster, no sub-carrier; colour bar – standard 8 band colour bar signal with PAL AB 75% contrast and 100% saturation; Grey scale – staircase with 8 steps from white to black level. Also provided via a coaxial socket, is a trigger output signal which enables accurate locking of an oscilloscope time-base at either line or frame frequency.

The instrument's small size, light weight and rugged construction make it the ideal unit for service calls to a viewer's home, or for base workshop service.

Further details from: Tecnico Electronics, Premier Street, Marrickville, N.S.W. 2204.

SAVE ENGINEERING DESIGN TIME WITH A DESKTOP CALCULATOR



A new 12-page booklet from Hewlett-Packard shows how electronic engineering design problems, that normally take days or weeks, can be solved in a few hours.

Using one of Hewlett-Packard's Series 9800 Calculator Systems and HP developed software, the designer can save time in the design of components, circuits, networks or systems. Calculator-aided design can be applied during the initial design phase or during product improvemen

The booklet suggests hardware/software solutions to problems in network analysis. Advantages of an alphanumeric printer and an X-Y plotter are clearly shown.

This new booklet entitled 'Calculator-Aided Design: The Time Saver' is available from Hewlett-Packard free of charge.

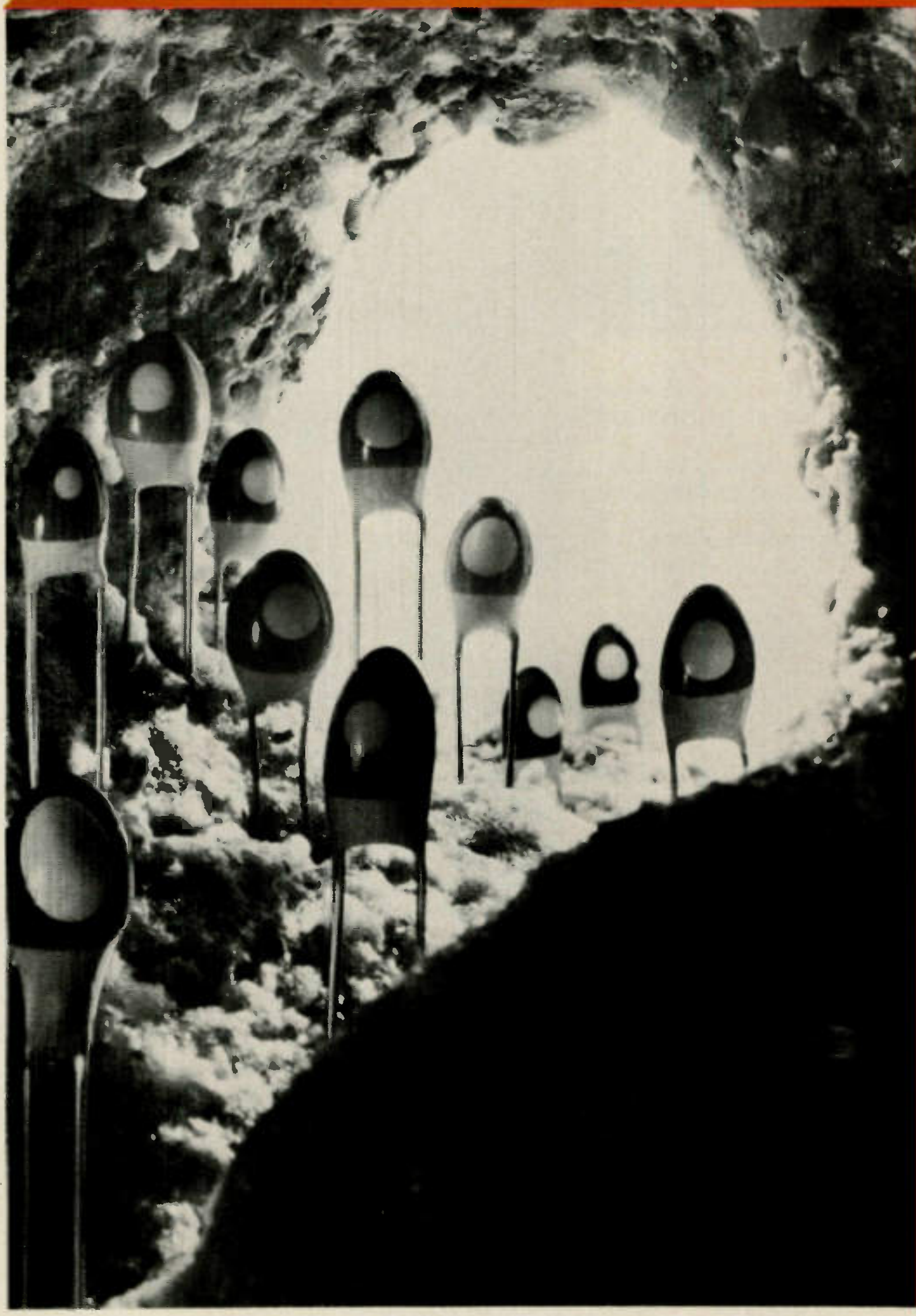
Marcom Dept., Hewlett-Packard Australia Pty. Ltd., 31-51 Joseph Street, Blackburn, Vic.

NEC SOLID TANTALUM CAPACITORS

NEC resin dipped tantalums are designed for decoupling, by-pass, blocking and filtering applications in both professional and domestic electronic equipment.

Features include relative low cost, small size, long term stability, long life, proven reliability and quality appearance.

They are fitted with uni-directional leads and are particularly suitable for printed circuit board application. The series is available in seven different case sizes.



Temperature Range
Continuous operation between -55°C and +85°C

Rated Voltage
3, 6.3, 10, 16, 20, 25 and 35V

Capacitance Range
0.1μF to 100μF

Capacitance Tolerance
+50-20, +20%

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0.04CV or 1μA whichever is greater

Humidity Grade
H5 as specified in DEF5011

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65W x 65W music power

FREQUENCY RANGE:
25 – 40,000 Hz ± 2dB

OUTPUT IMPEDANCE
4 – 16 ohms

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DISTORTION (TOTAL HARMONIC)
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At 25 Watts RMS @ 1 kHz = 0.1%
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POWER SUPPLY
240 volts AC

MODEL KTX-2000V
Size: 13.8" x 7.9" x 4.3"

SPECIFICATIONS:
Output Power:
15W x 15W RMS 8 ohms
40W x 40W music power

FREQUENCY RANGE:
25 – 30,000 Hz ± 2dB

OUTPUT IMPEDANCE:
4 – 16 ohms

DISTORTION (TOTAL HARMONIC)
1 watt = 0.14%
14 watts = 0.16%
16 watts = 0.18%

POWER SUPPLY
240 volts AC.

*** $85.43 Tax Inc.**

MODEL KTX-1200V
Size: 13.8" x 7.9" x 4.3"

SPECIFICATIONS:
Output Power:
6W x 6W RMS at 8 ohms
15W x 15W music power

FREQUENCY RANGE:
40 – 20,000 Hz ± 3dB

OUTPUT IMPEDANCE:
4 – 16 ohms

DISTORTION (TOTAL HARMONIC)
1 watt = 0.2%
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POWER SUPPLY
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COMPONENT NEWS

ADCOLA WHOLESALER FOR NORTHERN N.S.W.

Digitronics Australia Pty Ltd., Maryville N.S.W., has been appointed a wholesaler for Adcola soldering tools and associated equipment.

With the accent on decentralisation, the new appointment is expected to benefit industry in the northern regions of N.S.W.

GUNN OSCILLATORS FOR INTRUDER ALARMS

The new X-Band Gunn-effect oscillators, Types GDO 2-4, announced by Plessey Optoelectronics and Microwave Unit, are solid state microwave sources designed specifically for intruder alarm applications in the frequency ranges 9.2 – 9.9 GHz and 10.2 – 10.9 GHz.

These oscillators are intended for fixed frequency operation and can be preset to any frequency in the above ranges. Power outputs up to 100 mW are available. They have a frequency/temperature coefficient of 200 kHz/°C maximum and a power/temperature coefficient of –0.02 dB/°C maximum, over the temperature range –40°C to +70°C.

Commercial enquiries should be addressed to Plessey Optoelectronics and Microwave Unit, Wood Burcote Way, Towcester, Northants NN12 7JN U.K.

COMPONENT HOLDER FOR DO-7 SIZE DIODES

It is often necessary to mount discrete components on printed circuit boards, carrying integrated circuits, where space is restricted.

A new component holder from McMurdo allows diodes (DO-7 size) and similar size resistors and capacitors to be vertically mounted thus saving board area. Components are firmly held and protected from accidental damage.

Components up to 7.6 mm long and 3.17 mm dia. with leads not exceeding .78 mm dia. can be accommodated.

Leads exit from the holder on 3.8 mm to 5.1 mm centres.

The holder is moulded in flame retardent polypropylene and is suitable for continuous use at 120 degrees Celsius.

Further details from: McMurdo (Australia) Pty Ltd., P.O. Box 321, Clayton, Vic. 3166.

550 AMP THYRISTORS

Motorola have just introduced two new ranges of very high power thyristors rated at 550 A (rms) capable of withstanding non-repetitive peak currents up to 5500 A.

Known as types MCR550C and MCR550D, the devices are beam fired; that is, an internal network of circularly placed secondary cathode shunts amplify the initial gate current and direct them into the structure in beams radiating from the centre without sacrificing dv/dt capability. The result is an extremely fast, predictable turn-on without localised heating. In fact the thyristors can withstand a rise of on-state current at a rate of 1000 V/ us (non-repetitive) and 200 V/ usec (repetitive). Turn off time is 20 usec for the MCR550C devices and 30 usec for the MCR550D series.

Main applications for the new devices include industrial machinery and motor controls, cycloconverters, battery chargers, welders, lighting and heating control, power supplies, crane hoists and the like. Another device, the MCR800A, has also been introduced: this will handle up to 800 A.

FAIRCHILD DISTRIBUTION

Fairchild Australia, one of the largest semiconductor manufacturers, has announced the appointment of two new distribution outlets.

In Queensland, Warburton Franki have been newly apointed.

In Canberra, George Brown and Company takes over the distributorship from Electronic Components.

Mr. Bob Major, Marketing Manager of Fairchild said that the appointment and authorisation of these new distributors were further steps in the company's policy of making their semiconductor components readily and economically available to the entire electronics industry.

DECAPSULATION KIT

Epoxies, silicones, RTV, varnishes, urethanes, elastomers and other encapsulating compounds can now be dissolved with the aid of a decapsulation kit available from Royston Electronics Pty Ltd.

The kit, comprising a quart each of six specific compounds, was originally developed for the electronics industry for failure analysis, retrieval, and repair of packaged electronic components. Additional applications include chemical deflashing and equipment cleaning where removal of cured plastics is necessary, and the kit handles castings, mouldings, coatings and foams.

As an example of the kit contents, one compound – DECAP – is designed for the removal of cured epoxy systems, and is claimed to be particularly effective against transfer moulded epoxy. It causes disintegration by stretching and breaking up the cured materials. This compound is neutral, and will not affect electrical parameters of active components including silicon.

With the increasing use of complex plastics, the kit is now becoming a useful problem-solver in a wide range of industries.

Further details from: Royston Electronics Pty Ltd, 22 Firth St. Doncaster, Vic. 3108.

LOW-COST CRYSTAL OSCILLATOR

Ideal for reference oscillator and clock applications, a new crystal oscillator from Motorola features a choice of complementary sine wave, single-ended MTTL, and complementary MECL outputs from a single IC chip.

Designated the MC12060/12560 for operation from 100 kHz to 2.0 MHz, and the MC12061/12561 for the 2.0 to 20.0 MHz range, these devices operate with a fundamental series mode crystal. Stability is excellent, averaging -0.08 parts per million/degree centigrade (ppm/°C) for the MC12060/12560 -0.16 ppm/°C for the MC12061/12561 devices. The wide range of output combined with the high-stability make these new circuits suitable for many phase-locked loop applications.

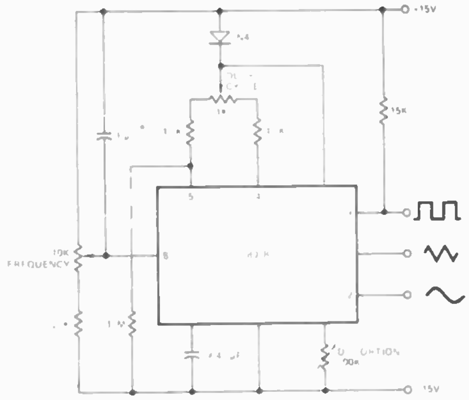
The medium-scale integrated circuit consists of a voltage regulator, an oscillator, an amplifier/automatic gain control, a sine to MECL translator, and a MECL to TTL translator. The only external components required to produce a highly stable oscillator are the crystal and two bypass capacitors, plus usual power supplies. Operation is from a single power-supply. Sine wave output voltages range from 800 millivolt peak-to-peak (no load) to 500 mV p-p at full load.

Series mode crystals are used with this IC oscillator, and it is possible to trim the oscillator frequency. By adding inductive components, the crystal frequency may be lowered; adding capacitive components will increase the fundamental crystal frequency. The components used to vary the frequency will have a direct effect on the circuit's stability. Slight frequency trimming may be desirable in frequency synthesizer applications.

Currently available in a 16-pin, dual-in-line ceramic package the 12060L/12061L are specified over the 0 to 70°C temperature range. The MC12060/12560 operate from 100 kHz to 2.0 MHz and the MC12061/12561 cover the 2.0 to 20.0 MHz range. The full military temperature operation (-55° to +125°C) is specified for the MC12560/12561 devices and will be available soon. Further details from: Motorola Semiconductor Products, Suite 204, Regent House, 37-43 Alexander Street, Crows Nest 2065.

W.H.K. SPECIALS

PRECISION WAVEFORM GENERATOR/VOLTAGE CONTROLLED OSCILLATOR



VARIABLE AUDIO OSCILLATOR, 20 Hz to 20 KHz

GENERAL DESCRIPTION

The 8038 Waveform Generator is a monolithic integrated circuit, capable of producing sine, square, triangular, saw-tooth and pulse waveform of high accuracy with a minimum of external components.

The frequency (or repetition rate) can be selected externally over a range from less than 1/1000 Hz to more than 1 MHz and is highly stable over a wide temperature and supply voltage range. Frequency modulation and sweeping can be accomplished with an external voltage and the frequency can be programmed digitally through the use of either resistors or capacitors. The Waveform Generator utilizes advanced monolithic technology, such as thin film resistors and Schottky-barrier diodes. The 8038 Voltage Controlled Oscillator can be interfaced with phase lock loop circuitry to reduce temperature drift to below 50ppm/°C.

8038CC Function Generator IC $6.04
20 page Application Notes $0.50.

DIGITAL CLOCK/CALENDAR CIRCUIT

FEATURES

- 28/30/31 DAY CALENDAR
- 12/24 HOUR CLOCK AND 24 HOUR ALARM
- SNOOZE ALARM
- 50/60 Hz OPERATION
- 6 DIGIT DISPLAY (HR., MIN., SEC.)
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- EASY INTERFACE WITH SPERRY TUBES
- DIRECT DRIVE TO LEO SEGMENTS
- CLOCK RADIO FEATURES
- ON CHIP 60 Hz BACK-UP
- EASILY SETTABLE COUNTERS
- DEPLETION MODE MOS/LSI
- SEGMENT AND DIGIT BLANKING
- SEGMENT AND DIGIT OUTPUTS CAN BE "WIRE OR'D" TO SHARE CALCULATOR DISPLAY
- SEVEN-SEGMENT OR BCD OUTPUTS AVAILABLE

GENERAL DESCRIPTION

The CT7001 is an extremely versatile MOS/LSI digital clock/calendar circuit. The CT7001 has many features which may be selected by various wiring configurations of the three scanned input pins. This enables the user to easily tailor the CT7001 to his specific requirements. It is available with either seven segment outputs (CT7001)

Setting any counter (time, alarm, calendar, and clock radio) is quite easy since a separate control of the hour and minutes digits has been provided. The setting of any counter does not affect the contents of any other counter.

Clock Chip CT7001 $17.25, large flourescent Display Tubes, direct interface $3.40ea. 6-digit multiplexed flourescent Calculator Display, direct interface $15.00. Application Notes $0.50.

3015F MINITRONS	2.20
7-segment LED DISPLAYS	1.90
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SN74193	2.69
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74S73 Schotty TTL	2.30
74S74 Schotty TTL	2.30
74S76 Schottky TTL	2.30
74S78 Schottky TTL	2.30
NE536T FET OP AMP. Input Impedance 10^{14} Ohm	7.90

NE540L Power Driver	2.98
SE540L Power Driver	6.03
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741C OP AMP	0.77
723C Precision Voltage Regulator	1.40
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Slowly but surely, sales of Electronic Today International are increasing.

Of course we are delighted — but an ever more serious world shortage of paper means that we must reduce wastage as much as possible.

In some areas, the magazine is already in short supply, and the situation may become worse.

There are two ways to ensure that you receive a regular copy: place a regular order with your newsagent, or take out a subscription which will cost you a bit more for postage, but will guarantee you your copy.

eti

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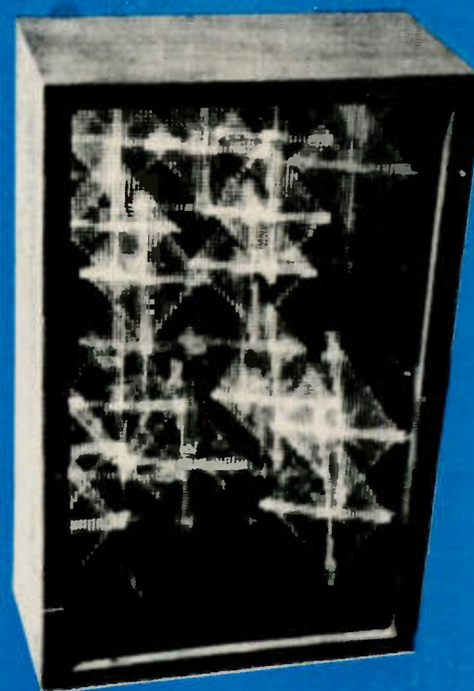
SECO® COLOR ORGAN

Colour organs are devices that use coloured lights activated by music. The lamps respond by colour to certain frequencies and intensities of music. They flicker and glow with varying brightness in relation to the volume, pitch and rhythm of the music. They can be used with small transistor radios, stereo amplifiers or live music systems wherever external speakers are used.



The **SECO V-3050** colour organ is far superior to any other colour organ models. It employs full solid state circuitry, and features a master sensitivity control plus an ON–OFF switch. The visual display consists of 30 diamond patterned lights flashing within an attractive teakwood cabinet. The organ easily connects to the terminals of a speaker and causes no decrease in volume, as the amplifier merely triggers the lights but does not drive them. Thus, it can be used with the smallest pocket radios as well as the largest stereo amplifier with no loss of sound whatsoever. All these advantages make the SECO **V-3050** the finest there is.

SPECIFICATIONS:

Frequency Range: 3 channels and 5 colours
Red for low frequencies
Yellow for low-mid frequencies
Green for mid-high frequencies
Blue for high frequencies
Violet for ultra-high frequencies

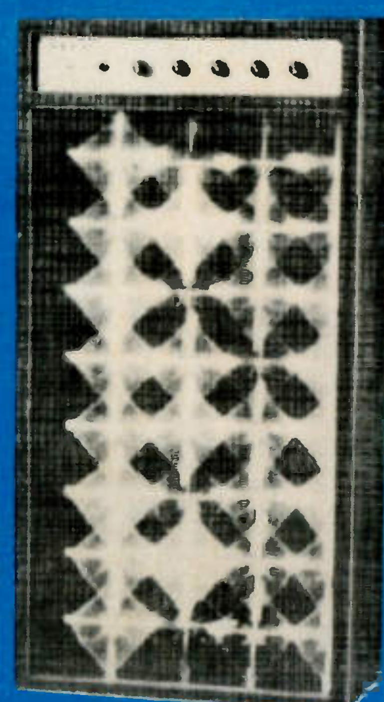
Input: 0.1 W. Connect to any 3–10 ohm output
Lights: 30 ea.
Pattern Type: Diamond Brilliance
Dimensions: 18½" (H) x 11½" (W) x 7-3/8" (D) (1.65 cu.ft.)
Weight: 3.5 kg.
Accessories: Operating instructions, audio line cord

PRICE ONLY:

$ 39·50

PACK POST: $2

SECO MODEL 4050X



Measuring 30-9/16" (H) x 15-5/16" (W) x 9-1/8" (D) (4.05 cu.ft.) and featuring 4 channels, 4 colours, 32 diamond patterned lights; 1 master control; 4 individual colour mixing controls and ON–OFF pilot light, the **SECO 4050X** is designed more for professional uses such as by entertainment groups. It features all the qualities of the Model V3050 and more! Once you see it, you will not be able to resist getting yours immediately.

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LETTERS FROM OUR READERS

LEWD ADVERTISING

I have read your magazine since the very first issue — admiring always your insistence on clarity of presentation without ever prejudicing technical accuracy. In particular I believe your page 5 editorials are among the best I have ever read in any field of magazine journalism. They are invariably, apt, concise and written in generally impeccable English.

Having said all that, I must now make what I feel to be a most serious criticism — that is of the lewd and offensive advertising that you occasionally carry.

You have an excellent publication. Why degrade it in this way?

H.L.P.,
Newcastle, N.S.W.

As our regular readers will know, this subject has been discussed before — although few previous complainants have written such otherwise complimentary letters.

In the past, we as most other publications, accepted or rejected advertising of the type concerned on a vague basis of what we thought would be acceptable to the majority of readers and their families.

In retrospect, one or two that we accepted we now regret publishing. Not that we thought, or now think, that the advertisements were in anyway indecent — but simply because they offended some of our readers.

But now the recently-introduced Restrictive Trade Practices Act has removed our right of veto. As long as an advertisement is neither dishonest nor legally pornographic, we cannot refuse to accept it — or insist that it be changed.

It distresses us to receive letters complaining about such advertisements but there is nothing we can now do about it. The advertisements in question are not pornographic nor in any way dishonest.

We can only suggest that, if you feel strongly about it, you write directly to the companies concerned. — Ed.

REDUCING RECORD NOISE

I have a quantity of old 78 rpm records that I would like to re-record onto tape cassettes. Is it worth while using a Dolby machine in order to reduce the existing noise on my records?

H.B. Homebush,
NSW.

The Dolby Noise Reduction system cannot reduce noise that already exists on programme material. Its purpose is to reduce the level of further noise that is inevitably introduced if the programme material is re-recorded.

Thus a noisy record will still sound just as noisy after re-recording regardless of whether a Dolby or non-Dolby machine is used.

If the 78's are of typical quality and condition, extra noise introduced during the re-recording process will be 'acoustically masked' by the existing record surface noise — so there is little point in specifically using a Dolby machine. If you have one — fine. But don't expect to hear any difference.

Much greater improvements can be made by experimenting with thorn needles, variable slope filters — or if available, an octave equaliser.

GA-LACTIC THEORY

Your report that US researchers had noticed similarities between lunar rock and Norwegian goat cheese ('Whey-Out', page 21, March issue) does not surprise me in the least.

I have always maintained that the moon was formed of galactic dust from the Milky Way — itself formed of milk from the breast of Juno by Jupiter's mighty hand.

The bit about Norwegian goats may seem hard to explain — but then, who knows the precise composition of goddess' milk?

We must wait until a space mission to the Via Lactis brings back a sample that can be analysed for butterfat content and other classifiable characteristics.

J.F.
Sen Jo-Han Da-Hsueh,
Shanghai, China

KRAFTY

Your news item headed 'Whey-Out' (ETI, page 21, March 1974) reported that US researchers had noticed similarities between lunar rock and Norwegian goat cheese.

Are we to assume that our lactophrenetic friends are on some sort of space junket?

R.S. University of New England, Armidale, NSW.

**Actually they weren't Americans. They were two Persians now working in Vietnam. Sort of Kurds in Hue — Ed.*

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74L06	.40	74L73	.80	74L164	2.95
74L10	.40	74L74	.80	74L165	2.95
74L20	.40	74L78	.80	85L52	2.95
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RECORDINGS

POP

REVIEWER: Mike Delaney

"Dredged from the subterranean scuzz-holes of the downstream Satyricon, we now confront you with a whole new generation of sleazoid ratpacks – New York Dolls! Tinker bell eat your heart out."

"New York Dolls" – New York Dolls. Phonogram/Mercury.

FRESH from Max's Kansas City, New York – the absolute murk pit of downtown Babylon where Andy Warhol's mid-sixties ouevre hung/hangs out still; now *the* spawning ground for rock's third generation bizarro-bands – the full ambi-sexual pop tart holocaust in the wake of Lou Reed, David Bowie, Mick Jagger; a combination of all three *plus* – the New York Dolls – as if Donny Osmond grew fangs midst heroin withdrawal and started writing songs about premature ejaculations.

New York Dolls – the forerunners, front row sniper squadron for such acts as the Teenage Lust, The Harlots Of 42nd Street, Wayne County & Queen Elizabeth. Amazingly, rock 'n' roll appears to have survived in New York, though limping somewhat in its latest disguise, all mascara decadence and sexual anarchy, picking up from where Alice Cooper leaves off and heading straight for the veins of the seventies' Satyricon.

The New York Dolls – rock 'n' roll plasticon in the finest Superdude Synthetic. Voila! The Violent Millenium: there's Eric Emerson, one-time Warhol superstar of "Chelsea Girls" and "Lonesome Cowboys" fame, decked out to look (literally) like a fairy, leaping, mincing, grinding it down and around to ethnic Jewish wedding music. Emerson heads the Magic Tramps, lead screeching, posuer numero uno. Tinker Bell, go eat your heart out.

Then, of course, there's Wayne County, a horrendously hideous-looking transvestite with a Southern accent as sharp as a razor blade and a style so gauche that even Alice Cooper and Lou Reed would beat a retreat down to the pool hall, leaving their nail polish at the door, were this number to come within a hundred yards of 'em.

"I'd better tell ya right now, honey, *ah am* hot tonight. HOT!" gasps this gorgon staring up from beneath a three foot bouffant silver-grey steel wool wig. And then comes the music, a blurred electric crunch topped off by grotesque, rasping vocals. The songs are indistinguishable; it's County who provides the show, with his t'wixt number raps and ever-more-torrid vulgarity: "This here toon is dedicated to mah favourite group, which is and always will be the Dave Clark 5. They was gorgeous, those boys had real class."

"So have you," shouts someone from the audience.

"Honey, I don't *have* class, I *give* it."

Hhmmm.

"This is a song about the days when love was free, before all the boys burnt out their energy fibres on acid and their girl friends got into mandrax." A pause, and then this kid in the lame jump suit, David Jo Hansen, a 17-year-old Michael Phillip Jagger mutation, starts up again: "When-I-say-I'm-In-Love – you-best-believe-I'm-In-LOVE – L-U-V!" Wham! And it's back to the New York Dolls, a total 6-string energy assault, stalking, pulping pulverizing: jarred chords mangled this way and that – the Dolls are *bad* – like the saying goes, they're good-bad, but *not* evil. After all, it's show-biz, *NOT* rock 'n' roll. But then it *has* to be rock 'n' roll, or noise, or chaos – or a little bit of all three perhaps. Whichever, rock sure ain't what it used to be – all denim clad serioso, the note that's all there is. Maybe. Maybe, that's all there *was*. Hhmmm – elbow room Dan'l Boone.

Essentially, on disc, the Dolls leave you feeling as if you've just been chundered all over, several times, from a 360 degree angle – an absolute toonless cacophony, sort of like diarrhoea, if you can follow the analogy. Like I said, it sure don't sound like any rock 'n' roll I've ever heard before.

So what's a bunch of New York plug uglies in exaggerated degenerate rooster hair-styles and manic-teen-pompadour clothing, the full Salvation Army disposable repulsives, just *what* do they think they're doing, trying to cut a sixties' feminine-macho talent like the Shangri-las, the full black patent leather "Leader Of The Pack" thing, and damn near *succeeding*!

Listen friends, these are the New York Dolls, the sweethearts of teenage wasteland themselves, the band you're going to love to hate and hate to love whether you *like* it or not; these *boys* who rip off the intro to "Give Him A Great Big Kiss" (this they apparently leave for an as yet unrecorded encore) for their own classic "Lookin' For A Kiss".

"Ah ain't uh . . . lookin' for a fix . . . ah-uh (S-C-R-E-E-C-H) Oh-no-ah-uh-uh . . . Oh-Nooooo . . . (limp-wristedly pointing to the veins of his right arm with a plastic hypo) . . . Ah'm just-a . . . lookin' for a KISS." Ah, the age of romance is upon us again – like a ton of bricks pounded down by the now customary million ton slag hammer guitar riff. Not bloody likely.

As you may have gathered, *this* song is about a sweet young lady whose house is being used by degenerates in order to fix up heroin, and all the pursed lipped hero wants to do is give her a great big kiss for her trouble. "Ah que-pasa New York" as John Lennon would say. *Only* in New York.

The Dolls are all New York teens and that alone *should* speak for itself. On their first cross country tour as support for Mott The Hoople, they got busted three times: once for obscene posturing and language; twice for completely wrecking their 'Holiday Inn' motel rooms, the first for spray painting *everything* deep chartreuse (EVERYTHING – walls, beds, windows, carpets, fixtures, fittings . . .); the second time for axing all the furniture and heaving it twelve floors down into the swimming pool. Shades of the Stones, aggro-punk like the earliest Who: whichever, the

Dolls have already mastered one very real rock 'n' roll trick – the art of head-lines right the way across America and England.

Several months back, the Dolls debacle started with an immense hype, ending with their move to England and subsequent death of original drummer, Billy Murcia. All this, in such a relatively short time, has welded the usual 'bored deathless' pose of any punkoid band into a permanent, deadpan, impenetrable sneer. In America at least, it seems to sell a lot of records.

Since that time, due mainly to the many reviews, they have been courted by every major league recording outlet, signing last year with Mercury/Phonogram. Already, their first album, simply titled "New York Dolls", produced by fellow McLuhan-aged rock mutant, Todd Rundgren, is out and up past the 150,000 sales figures.

The Dolls are at the helm, the peak fame-wise of the newer third-wave band decadents. Their only real competition appears to be the Modern Lovers, a Boston combo which features Jonathan, a Dustin Hoffman look-a-like who appears on stage at every concert shouting; "I'm straight . . . I'm not on marijuana . . . I don't take acid . . . I'm not a hippie boy . . . I'm telling you I'm straight . . ." Pretty good, huh?

The Dolls are mostly towards the mainstream rock fantasy, humping the old punk outlaw myth. And those songs! Much is absolute dross, total weirdo-squirm power like "Vietnamese Baby" and "Private World", but just wait till you hear such bonafide nouveau-rock classics as "Trash" ("I saw that girl you took to the high-school prom, honey, and she was – chorus – TRASH – don't pick it up – TRASH – don't take that life away") or the blockbusting "Personality Crisis" which features Sylvain Sylvain and Johnny Thunder rocking out their one and only guitar lick to perfection.

As far as one can make out, the Dolls' charm seems to be their ability at parodying the rock mystique. While the Stones are funkier and more assured, what the Dolls have is *all* in terms of sass, vulgarity, energy and fun. They make the Stones sound like angels. Simply, the Dolls are high camp – like with their superb choice of oldies. These boys dig down deep into the bowels of rock and dangle outrageously the skeletons of archival hits by the Drifters, Searchers, Dion & The Belmonts, even Question Mark & the Mysterians. But then if you don't remember, it's probably just as well.

But like I said earlier, the New York Dolls are bad – not evil, just thoroughly good/bad. Their first album is captured on Mercury Records, released locally through Phonogram. Jim Morrison said it best: "I've been down so God damn long, it looks like up to me." Betcha the Dolls know exactly what he means.

Be warned. ●

TECH TIPS

Extending the range of a stabilized power supply.

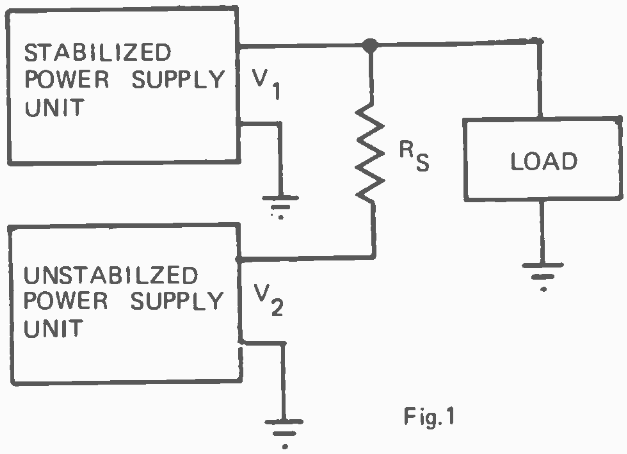


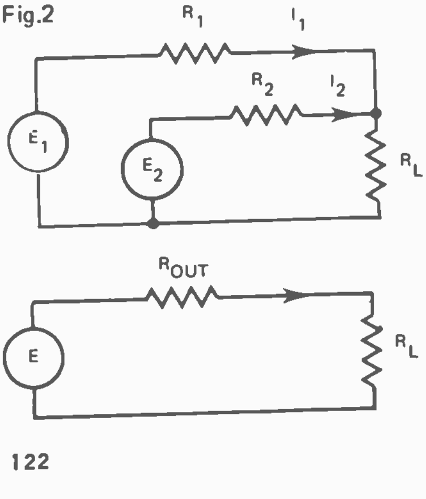
Fig.1

STABILIZED bench power supplies capable of meeting most laboratory requirements are readily available. Nevertheless all too often units in the laboratory have current ratings inadequate for the job in hand. Bench power supply units can normally be connected in parallel to provide higher load current, and this is often the most convenient way of solving the problem.

It is not always realized, however, that, in applications where load fluctuations are limited, additional current can be drawn from a simple *unstabilized* power unit, without noticeable deterioration in overall performance. The unstabilized unit is connected, via a series resistor, in parallel with the stabilized unit as shown in Fig.1. The action of the network is as follows.

Two generators connected in parallel have the overall characteristics of an equivalent single generator (as shown in Fig. 2). The source resistance of the equivalent generator is equal to the parallel combination of the individual source resistances and is thus lower than either of them. If we regard generator E_1 as the stabilized supply, R_1 will be very small compared with R_2, so that the effective emf, E, will be nearly equal to E_1. Furthermore, as R_1 must, in practice, be very small indeed compared with R_L, the voltage across the load will also be virtually equal to E_1.

Fig.2



In the normal circumstance E_1 is determined by the requirements of the load circuit and E_2, the unstabilized source voltage, is set by the power unit that is to hand. So the only practical variable is the value of resistor R_S in Fig. 1. This is, of course, equal to $(V_2 - V_1)\ I_2$, but it is not equal to R_2 in Fig. 2 because R_2 also includes the internal source resistance of the unstabilized supply; and, by the same token, V_2 is less than the easily checked open-circuit voltage, E_2, by the potential difference across the internal resistance.

In practice this internal source resistance is unlikely to be known and, although it is not difficult to measure, the value of R_S can be found without it.

When the required load current exceeds the stabilized unit's rating by only a small amount, or when the voltage difference between the two supply units is small, the power dissipated in R_S will also be small. It may then take the form of a variable resistor, which can be adjusted to bring the current drawn from the stabilized unit to a value below its maximum rating. The maximum value of the variable resistor should be approximately the calculated resistance for R_S with the unstabilized supply's internal resistance taken as zero; i.e. $(E_2\ E_1)/I_2$.

If the power to be dissipated in R_S is too high for convenient use of a variable resistor, its value can be found by, first establishing the value of V_2 by the use of a dummy load passing a current equal to I_2, and then calculating R_S by Ohm's Law $R_S = (V_2 - V_1)/I_2$. Usually, however, when the power in R_S is high, its resistance is significantly higher than the internal resistance of the power unit, which may then be neglected.

When setting the value of R_S, it is important to allow for variations in the unstabilized voltage due to mains input voltage fluctuations. This is easily done by basing any calculations on a value for V_2 which is 10% below the value measured with the correct input voltage.

For example, suppose we have a stabilized unit rated at 30 V, 1 A, with an output resistance (R_1), of 10 mΩ, but the actual maximum load current is 1.5 A. An unstabilized supply with a normal open circuit voltage of 40 V, connected via a total series resistance of 20Ω, could be used to provide the 0.5 A additional current. The combination would be equivalent to a single generator with a source emf of 30.02 V and a source resistance of nearly 10 mΩ, i.e., characteristics very little different from those of the stabilized supply alone.

However, if the unstabilized voltage were to fall by 10%, the current, I_2, would drop to 0.3 A, so that the stabilized unit's current rating would be exceeded. It would, therefore, be advisable to reduce the total series resistance to 12 Ω to allow for such variations. At nominal mains voltage the unstabilized unit would deliver 0.83 A, so that the stabilized supply would be operating well within its rating; and, in the event of the mains voltage rising to 10% above nominal the unstabilized unit would deliver 1.2 A at full load, so that the stabilized unit would only be supplying 0.3 A.

In this example, the load regulation within the range 1.2 A to 1.5 A (allowing for maximum mains fluctuations) would be very slightly better than that of the stabilized power supply when operating within its current rating. Ripple from the unstabilized unit would be reduced by

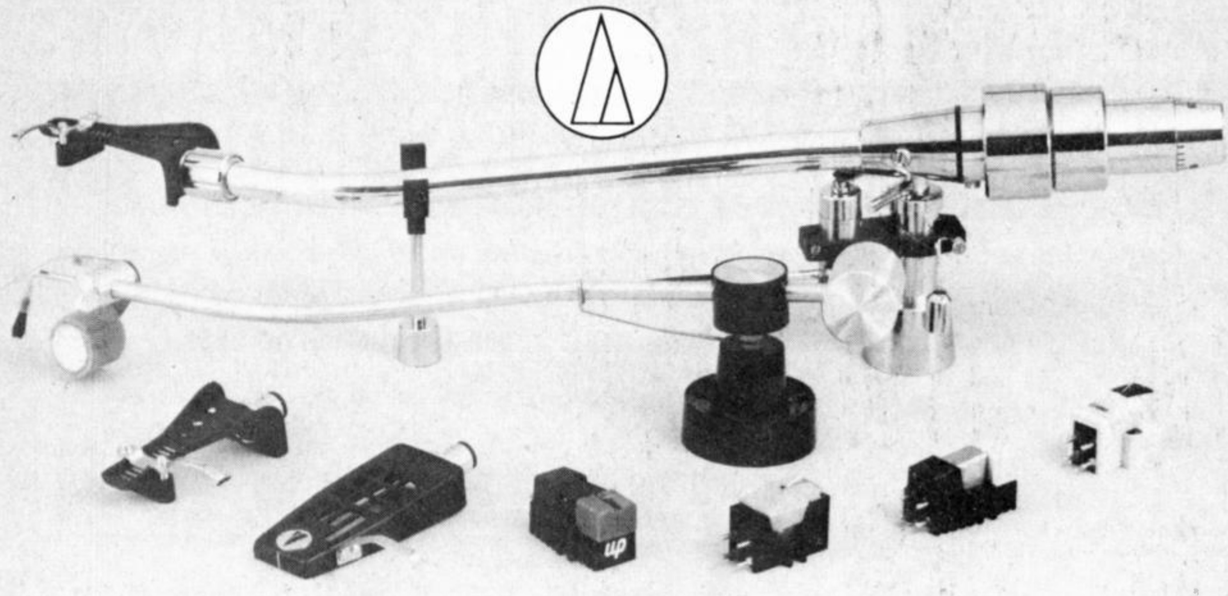
[redacted]

the factor $(R_1 + R_2)R_1$ or, in this case, 1200 times.

Care must be taken, however, not to allow the load current to reduce to the level where it is supplied *entirely* by the unstabilized unit. If this condition occurs, the regulation is lost, and the voltage rises as the load current falls with possible damage to the stabilized supply and the load components.

It is also important to switch ON in the correct sequence. Many bench power supplies are protected by a built-in current-limiting circuit, so that the stabilized supply can be applied to the load first with complete safety, and the unstabilized supply switched on afterwards to provide the additional current needed, however not all supplies have this protection. ●

Based on data supplied by Weir Electronic Instruments Limited.



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Specifications for AT-Cartridges	AT-VM8 series	AT-VM3	AT-VM3X	AT-35 series	AT-VM35	AT-VM35F	AT-66 series	AT-21 series
Type	VM	VM	VM	VM	VM	VM	DM	DM
Frequency Range (Hz)	20–35,000	20–40,000	20–40,000	10–40,000	10–41,000	10–45,000	20–20,000	10–25,000
Channel Balance (dB, at 1 kHz)	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5	±1	±0.5
Channel Separation (dB, at 1 kHz)	30	30	30	30	30	30	28	30
Output Voltage (mV, at 1 kHz, 5 cm/sec. rms.)	4	4	4	5	4	2	4	4
Compliance ($\times 10^{-6}$ cm/dyne)	17 (AT-VM8) 20 (AT-VM8X)	26	27	24	28	28	22	25
Tracking Force (gram)	3.0–5.0 (AT-VM8) 2.0–4.0 (AT-VM8X)	1.0–2.0	1.0–2.0	0.8–2.2	0.5–2.0	0.5–2.0	1.0–2.5	0.8–2.0
Weight (gram)	6.5	6.5	6.5	6.0	6.7	6.7	7.5	7.5
Recommended Replacement Stylus	VM8-7D VM8-EL	VM3-5D	VM3-EL	AT35-5D AT35-EL	VM35-EL	VM35-FD	AT66-7D AT66-EL	AT21-5D AT21-EL

Specifications for AT-Tone Arms	AT-1005 II	AT-1007
Overall Length (mm)	323	327
Effective Length (mm)	240	240
Overhung (mm)	15	15
Maximum Tracking Error Angle	1° 30′	1° 30′
Tracking Force (gram)	0–3.0	0–2.5
Weight of Applicable Cartridges (gram)	5–24	5–24
Turntable Height (mm, approx. as measured at cartridge thickness of 18 mm)	30–57	25–85
Head Shell	Model S: weight 8.5 grams	Model UL: weight 6 grams
Vertical Bearing	Pivot Bearing	Pivot Bearing
Horizontal Bearing	Radial Ball Bearing	Radial Ball Bearing
Effective Mass (gram)	20 (with AT-VM35F)	13 (with AT-VM35F)
Remarks	Fitted with anti-skating mechanism and can be fitted with arm lift	Fitted with anti-skating mechanism and hydraulic arm lift

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