

# Electronics Today

INTERNATIONAL



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**SURFACE  
MOUNTING  
COMES  
OF AGE**

**INSIDE SYDNEY'S  
NEW SCIENCE  
MUSEUM**

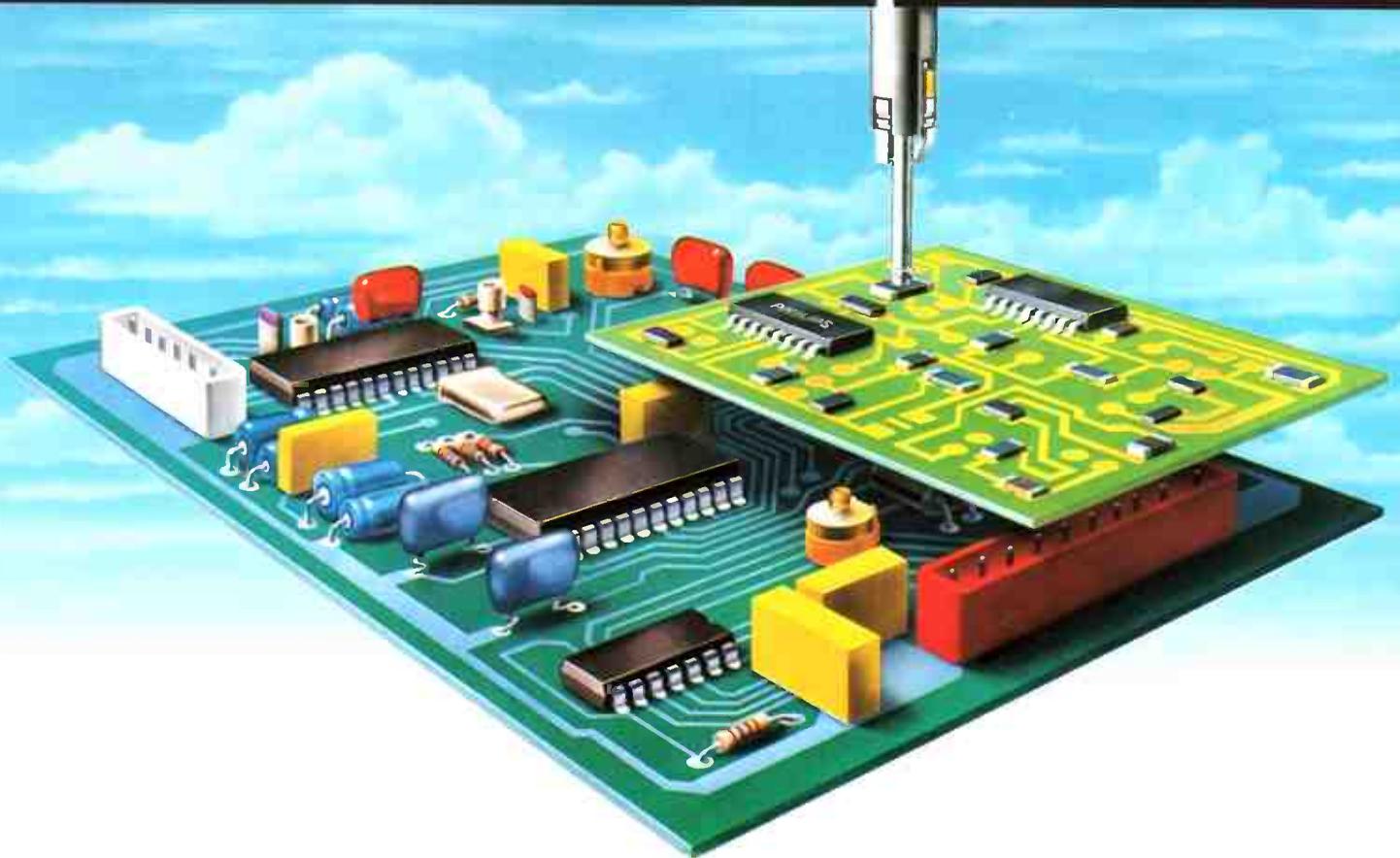
**ARE VIDEO  
TERMINALS  
DANGEROUS?**

**BUILD:**

- Stand alone speech synth
- Patch Bay
- Shock triggered car alarm

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# Philips SMDs offer a lot of room for improvement



Philips Surface Mounted Devices give you plenty of room to improve the design, manufacture and performance of your products.

Because they not only take miniaturisation a major step forward, but also make circuit boards less costly and dramatically more reliable.

Smaller boards, closer placement, and because the devices are mounted on, not through the board, the designer can use both sides of the PCB.

Philips SMDs are designed for automation, and Philips is a leader in the specialised automation equipment to accurately site the SMDs. Your products are assembled faster, and more efficiently. And because these components are so

highly reliable, the failure rate – during manufacture and in the field – is significantly reduced.

So, before you begin a new design using conventional components, talk to Philips about SMDs.

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Perth (09) 277 4199 Brisbane (07) 44 0191

or write to **Philips Electronic Components and Materials**

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Artarmon NSW 2064.



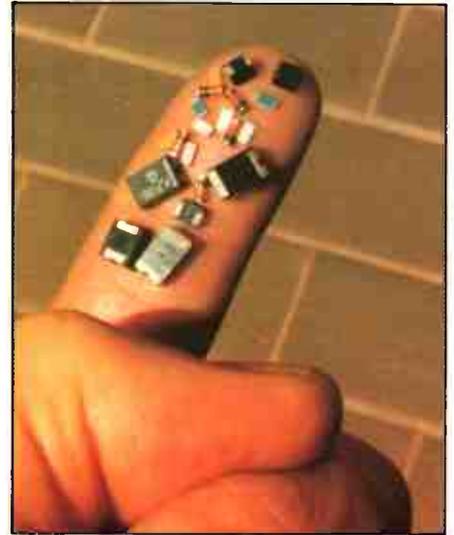
**Electronic  
Components  
and Materials**

# PHILIPS



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## SOUND INSIGHTS

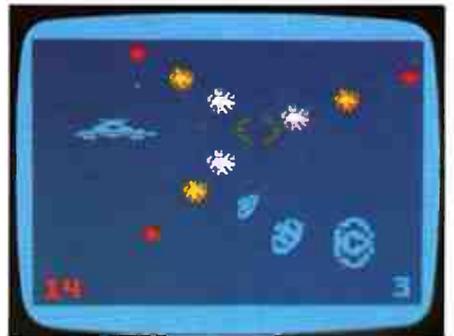
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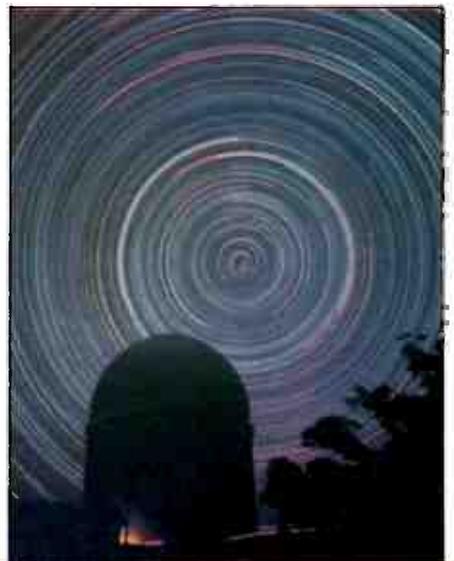


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COVER: Bandoliers of surface-mount components from Philips.



### "NO BRAND" DISKS!

Now you can buy absolute top quality disks that are also the cheapest in Australia! They even come with a 5 year guarantee, which indicates the quality of these disks. So why pay 2-3 times the price for the same quality? Packs of 10, D/S D/D without boxes, or brand name, just their white paper jacket, and index labels. (5 1/4" disks includes write protects).

#### 5 1/4" DS/DD

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10+ DISKS 100+ DISKS 1,000+ DISKS  
**\$9.00<sup>ea</sup> \$8.50<sup>ea</sup> \$8.00<sup>ea</sup>**  
(All prices per 10 disks. Tax exempt prices less \$1)

#### 3 1/2" DS/DD

### "NO BRAND" DISKS!

10+ DISKS 100+ DISKS 1,000+ DISKS  
**\$27 \$26 \$24**  
(All prices per 10 disks. Tax exempt prices less \$4)



### VERBATIM DISKS!

(All prices per box of 10 disks)

DESCRIPTION	1-9 BOXES	10+ BOXES
3 1/2" 1S/2D	<b>\$44.95</b>	<b>\$42.95</b>
3 1/2" 2S/2D	<b>\$46.95</b>	<b>\$43.95</b>
5 1/4" 1S/2D	<b>\$22.00</b>	<b>\$21.00</b>
5 1/4" 2S/2D	<b>\$26.00</b>	<b>\$24.00</b>
5 1/4" 2S/HD	<b>\$42.95</b>	<b>\$41.00</b>



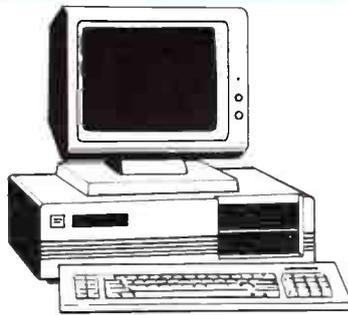
### MICRODOT DISKS!

DESCRIPTION	1-9 boxes	10+ boxes
3 1/2" 2S/2D	<b>\$29.95</b>	<b>\$28.95</b>
5 1/4" 1S/2D	<b>\$12.95</b>	<b>\$11.95</b>
5 1/4" 2S/2D	<b>\$13.95</b>	<b>\$12.95</b>



### SAMSUNG 12" 20MHz COMPOSITE MONITOR ONLY \$129

- High contrast, non-glare screen
  - High resolution, 80 or 40 character display
- | CAT.No. | DESCRIPTION | PRICE        |
|---------|-------------|--------------|
| X14514  | (GREEN)     | <b>\$129</b> |
| X14516  | (AMBER)     | <b>\$129</b> |
- (10 OR MORE ONLY \$119<sup>ea</sup>)



### IBM\* XT\* COMPATIBLE COMPUTERS FROM \$695

Check these features and our prices. We're sure you'll agree they're exceptional value for money!

- Final assembling and testing in Australia!
- AT\* style keyboard
- Tested by us for 24 hours prior to delivery!
- 8 Slot motherboard
- 12 months warranty!
- 150W power supply
- Switchable 4 77MHz Turbo versions available for an extra \$50

### \*\$695 COMPATIBLE COMPUTER

256K RAM Single Drive, Graphics and Disk Controller Card. (Basic 4 77MHz) **\$695**

### 256K RAM COMPATIBLE COMPUTER

2 x 360K Disk Drives, Multifunction Card, Colour Graphics, Disk Controller, 1 Parallel Port. (Includes Timer Disk) **\$945**

### 10 MHz TURBO, 640K RAM COMPATIBLE COMPUTER

2 x 360K Disk Drives, Multifunction Card, Colour Graphics, Disk Controller, 1 Serial, 1 Parallel Port. (Includes Timer Disk) **\$995**

**WITH 20 M/BYTE HARD DISK:**  
& single 360K Floppy Disk Drive **\$1,495**  
& dual 360K Floppy Disk Drives **\$1,595**

**WITH 40 M/BYTE HARD DISK:**  
& single 360K Floppy Disk Drive **\$1,945**  
& dual 360K Floppy Disk Drives **\$2,045**

**WITH 80 M/BYTE HARD DISK:**  
& single 360K Floppy Disk Drive **\$3,795**  
& dual 360K Floppy Disk Drives **\$3,950**

### IBM\* AT\* COMPATIBLE COMPUTER \$2,795

- Final assembling and testing in Australia!
- 1 M/Byte Main Board
- 6 MHz
- 1.2 M/Byte Floppy Disk Drive
- 80286 CPU
- Colour Graphics Display Card
- 8 Slots
- Floppy & Hard Disk Controller
- 20 M/Byte Hard Disk
- Printer Card and RS232
- Keyboard
- 200W Power Supply
- 6 Months Warranty

### BABY AT\* COMPATIBLE COMPUTER! FROM \$1,695

- Final assembling and testing in Australia!
- 1 M/Byte Main Board
- Switchable 8/10/12 MHz
- 1.2 M/Byte Floppy Disk Drive
- 80286 CPU
- Colour Graphics Display Card
- 8 Slots
- Floppy & Hard Disk Controller
- Printer Card and RS232
- Keyboard
- 200W Power Supply
- Manual
- 6 Months Warranty
- Dimensions: 360(W) x 175(H) x 405(D)mm

**SHORT BABY AT\* 512K RAM... \$1,695**

**STANDARD BABY AT\* 1 M/BYTE RAM,**

hard disk drive..... **\$2,295**

**WITH 20 M/BYTE HARD DISK ..... \$2,795**

**WITH 40 M/BYTE HARD DISK ..... \$2,795**

**WITH 80 M/BYTE HARD DISK ..... \$4,295**



### XT\* MOTHERBOARD (WITHOUT MEMORY)

- 4 77MHz
- 8088 Processor
- Expandable to 640K on board
- Provisions for up to 6 x 2732 EPROMs on board
- Keyboard connector
- 8 Expansion slots

Cat.X18020 (Excl. Ram) **\$119**

Cat.X18026 (Incl. Ram) **\$314**

### XT\* TURBO MOTHERBOARD

- 8MHz
- 8088 Processor
- Expandable to 640K on board
- Provisions for up to 6 x 2732 EPROMs on board
- Keyboard connector
- 8 Expansion slots

X18030 (excl. RAM) **\$169**

X18031 (incl. 640K RAM) **\$359**



### 10 MHz XT\* TURBO MOTHERBOARD

Increase the performance of your sluggish XT\* approximately four times with this super fast motherboard.

- 8088-2 running at 10 MHz, no wait state
- Turbo/Normal selectable
- 640K fitted
- 8 Expansion slots
- 4 Channel DMA
- Keyboard port

Excluding RAM .. **\$249**

Including RAM) .. **\$419**



### 6/10 MHz AT\* MAIN BOARD

- 6/10 MHz system clock with zero wait state
- Hardware and software switches for alternative system clock
- Rechargeable battery backup for CMOS configuration table and real time clock.
- 80286-10 microprocessor
- Socket for 80287 numeric data co-processor
- 256KB, 512KB, 640KB, or 1.024KB RAM
- 64KB ROM, expandable to 128KB
- 8 Input/Output slots
- Hardware reset jumper
- Power and turbo LED connector
- Phoenix BIOS

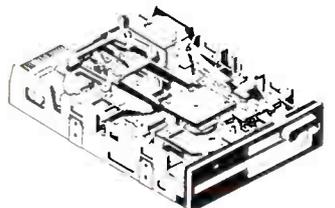
X18100 (Excl. RAM) **\$689**

### BABY AT\* MOTHERBOARD (WITHOUT MEMORY)

- 6/10 MHz system clock with zero wait state
- 80286-10 Microprocessor
- Hardware and software switchable
- Socket for 80287 numeric data co-processor
- 256K, 512K, 640K, or 1.024K RAM
- 64K ROM
- Phoenix BIOS
- 8 Expansion slots

X18200 (excl. RAM) **\$689**

X18201 (incl. 640K RAM) **\$889**



### NEC 1-2 M/BYTE DISK DRIVE

Top quality at an incredibly low price! Double sided, double density. Switchable 1.2 M/Byte to 720K formatted capacity IBM\* AT\* compatible

C11906 .. **ONLY \$269**

### NEC 3 1/2" DISK DRIVE

A top quality double sided, double density drive at an amazing price! 1 M/Byte unformatted, 640K formatted. Access time 3 m/sec.

C11905 .. **ONLY \$255**

### MITSUBISHI 4851 DISK DRIVE

Slimline, 360K, Double sided, double density

C11901 .. **ONLY \$229**

### 20 M/BYTE HARD DISK

Tandon, including DTC controller card, 12 month warranty. IBM\* compatible.

X20010 .. **ONLY \$595**

### 40 M/BYTE HARD DISK

Seagate, 12 month warranty. IBM\* compatible. For technical details phone Mark Stevens on (03) 543 7877

..... **ONLY \$795**

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Regardless of where you live in Australia, you can take advantage of Rod Irving's exceptional prices either through our Melbourne stores or our Mail Order Service. Simply phone your order through on (008) 33 5757 for the cost of only a local call. (Inquiries to (03) 543 7877)



## RS232 & CLOCK CARD (WITHOUT CABLE)

This RS232 card supports 2 asynchronous communication ports. Programmable baud rate generator allows operation from 50 baud to 9600 baud. Fully buffered. Clock includes battery back-up and software.

Cat. X18028 ..... **\$89**

## RS232 (SERIAL) CARD (WITHOUT CABLE)

This RS232 card supports 2 asynchronous communication ports. Programmable baud rate generator allows operation from 50 baud to 9600 baud. Fully buffered. Second serial port is optional.

Cat. X18026 ..... **\$49**

## CLOCK CARD

Complete clock card including battery back-up and software.

Cat. X18024 ..... **\$55**

## GAMES I/O CARD

Features two joystick ports. (DB15).

Cat. X18019 ..... **\$37**

## I/O PLUS CARD

Provides a serial port, a parallel port and a joystick port, and even a clock/calendar with battery backup!

Cat. X18045 ..... **\$119**

## 768K MULTIFUNCTION I/O CARD

(Includes cable but not 41256 RAM)

- Serial port
- Parallel port
- Games port
- Clock/Calendar with battery back-up
- Provision for second serial port

Cat. X18050 ..... **\$194**

## DTC HARD DISK CONTROLLER CARDS

X18060 (XT) ..... **\$190**

X18140 (AT) ..... **\$290**

## SEMICONDUCTORS

Description	1-9	10+
V-20 8MHz	<b>\$14.95</b>	<b>\$13.95</b>
V-30	<b>\$39.95</b>	<b>\$34.95</b>
41256 (150ns)	<b>\$6.95</b>	<b>\$6.50</b>
41256 (120ns)	<b>\$8.95</b>	<b>\$7.95</b>
41256 (100ns)	<b>\$9.95</b>	<b>\$9.75</b>
4164 (150ns)	<b>\$1.95</b>	<b>\$1.85</b>



## MULTI I/O & DISK CONTROLLER CARD

This card will control 2 x double sided, double density drives, and features a serial port, a parallel port, and a joystick port or games port. It also has a clock/calendar generator with battery backup.

Cat. X18040 ..... **\$145**

## MULTI SERIAL CARD

- 4 RS232C asynchronous communication serial ports. One fitted 3 optional.
- NS16450 Asynchronous communication elements (ACE)
- COM1/COM2 COMPATIBLE
- DTE/DCE Selectable
- Drive support for PC\*/AT\*, XENIX\*
- Interactive installation procedure available.

X18154 ..... **\$139**

## 16 BIT FLOPPY DISK DRIVE CONTROLLER CARD

These cards will control up to 2 or 4 double sided 360K IBM\* compatible disk drives.

X18005 (2 Drives) . **\$52**

X18006 (4 Drives) . **\$55**

## 1-2 M/BYTE/360K FLOPPY CONTROLLER CARD

The ideal solution for backing up hard disk, archiving etc. Suitable for 1-2 M/Byte and 360K drives. XT\* and AT\* compatible

Cat. X18008 ..... **\$124**



## VERBATIM 20 M/BYTE HARD DISK CARD

IBM\* compatible, plugs straight in to your computers bus connectors!

X20020 ..... **\$1,095**

## 640K RAM CARD (SHORT SLOT)

- 640K memory installed
- User selectable from 64K to 640K
- DIP switches to start address

X18014 .. **ONLY \$229**

## 2 M/BYTE RAM CARD

Plugs straight into BUS ports on motherboard. XT\* compatible. RAM not included.

X18052 (Excl.RAM) **\$194**

## 386 MAIN BOARD

- Intel 80386 CPU (16MHz)
- Socket for 80387 Math co-processor
- 32 bit BUS system, 1 M/Byte or 640K on board memory.
- Built-in speaker attachment
- Battery backup for CMOS configuration table and real time clock.
- Keyboard controller and attachment
- 7 Channel DMA
- 16 Level interrupts
- 3 Programmable timers
- 8 System expansion I/O slots:
  - 5 with a 36 pin and a 62 pin expansion slot 2 with only the 62 pin expansion slots 1 with two 62 pin expansion slots (32 bit BUS)

X18101 ..... **\$2,489**

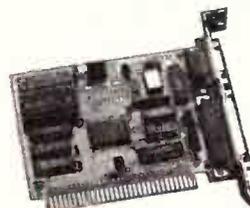


## COLOUR GRAPHICS CARD

This card plugs straight into I/O slot and gives RGB or composite video in monochrome to a monitor.

Colour graphics: 320 dots x 200 lines.  
Mono graphics: 640 dots x 200 lines.

Cat. X18002 ..... **\$107**



## GRAPHICS CARD

- Hercules compatible
- Interface to TTL monochrome monitor
- One Centronics parallel printer port
- 2K-Static RAM, 64K Dynamic RAM
- Display Mode: 720 dots x 348 lines

Cat. X18003 ..... **\$139**

## COLOUR GRAPHICS & PRINTER CARD

This combination card features printer and monitor interface. It has 1 parallel printer port, composite colour, RGB CTTC outputs as well as composite monochrome video output with display buffer.

**Colour:**  
Text Mode: 40 columns x 25 rows.  
Graphics: 320 x 200

**Monochrome:**  
Text Mode: 80 columns x 25 rows.  
Graphics: 640 x 200

Cat. X18010 ..... **\$124**

## PRINTER CARD

This card features a parallel interface for Centronics printers such as the Epson RX-80, 100, and other similar printers. Included is printer data port, printer control port, and printer status port.

Cat. X18017 ..... **\$35**



## ENHANCED GRAPHICS ADAPTOR CARD

- 256K display RAM
- Handles monochrome, CGA Hercules and E.G.A.
- Paradise\* compatible
- Up to 16 colours
- Standards: 320 x 200, 640 x 200, 640 x 348, and 720 x 348.

X18070 ..... **\$239**

# rie

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The above postage rates are for basic postage only. Road Freight, bulky and fragile items will be charged at different rates.

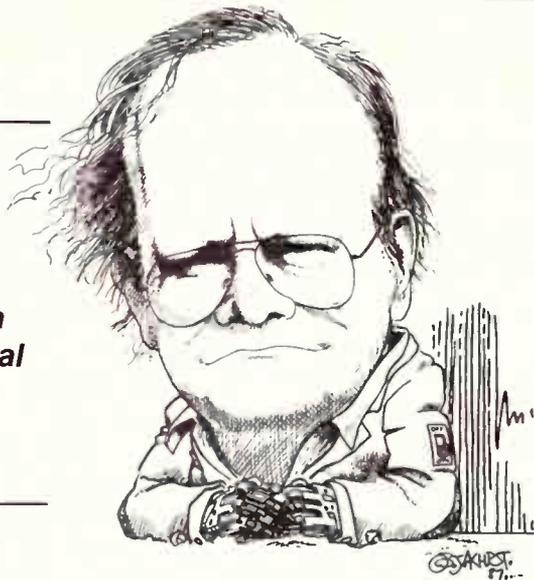
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“  
**data traffic on the  
 network has grown  
 alarmingly, and data  
 calls observe no social  
 conventions**  
 ”



Recently, Telecom Australia has been considering time charging for local calls, as is done by most overseas telephone companies. The move has been in the wind for several months (See News Digest April 1987) so it will cause little surprise that the issue has come to a head. Nevertheless, Telecom's response to the problem is ill advised.

It appears that behavioural norms have developed in the way we use the telephone which keep calls relatively brief. Indeed, the total capacity of the telecommunications network is designed around an average call length of three minutes. Telecom's pricing has evolved to support the infrastructure needed to cope with this pattern of calling behaviour.

However, during the last five years, data traffic on the network has grown alarmingly, and data calls observe no social conventions. Typically, they last many times longer than voice calls, and indeed, business users with a need to maintain real time links for their computer operations may well wish to maintain a switched line on a semi-permanent basis.

As things stand, there is nothing to prevent this.

The result is that data traffic is forcing Telecom to install a much bigger switched network than is indicated purely by the number of subscribers. The question for Telecom is: what to do about it? Telecom management has elected to time all local calls. They have set their prices so that people who use the phone within the normal conventions will not suffer. Indeed, 16c for four minutes is a better deal for the typical subscriber than 20c for ever.

On the other hand, not everyone is typical. The service Telecom provides is seen, not as a privilege, but as a right by the Australian community. Many, particularly the aged and infirm, use it as a fundamental means of communications, more important even than face to face contact. Forcing those least able to pay to subsidise data traffic is morally indefensible as well as politically unwise.

Telecom claims it can recognise underprivileged subscribers and make allowance for them. This claim is quite false, indeed it is so obviously false one wonders why Telecom management made it in the first place. Equally false is the claim that it is

*Continued*

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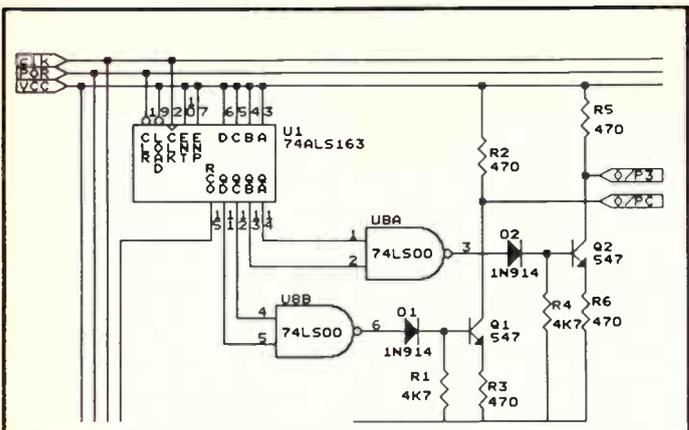
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**OrCAD A CUT ABOVE THE BEST**

OrCAD/SDT The advanced SCHEMATIC CAPTURE package  
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This powerful combination now gives you the ability to "electronically breadboard" your design on your work desk

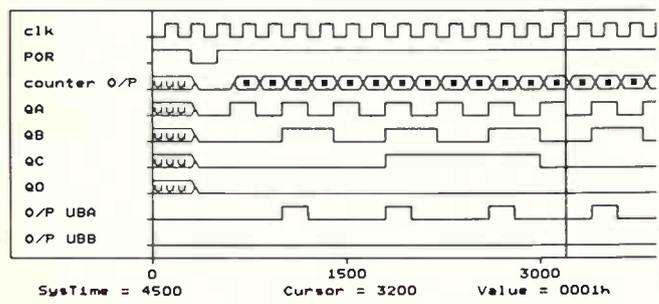
**OrCAD/VST Features :-**

- 14,000+ Gate capacity
- 50 Channels (signal or buses)
- 10,000 events per second (8MHz AT)
- Selectable sampling times
- Plus many other facilities

**OrCAD/SDT features :-**

- Over 3700 unique library parts
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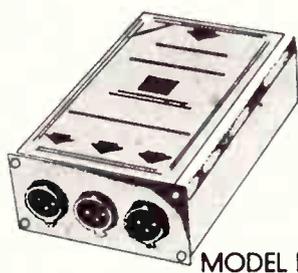
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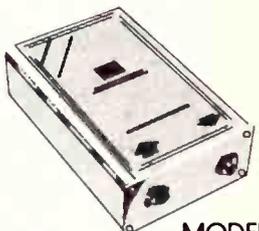
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**MIC-SPLITTERS**



MODEL MS14

**ACTIVE DIRECT BOXES**

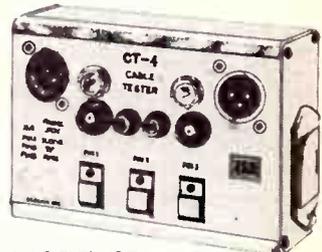


MODEL SM2MKIII

**GENERAL PURPOSE AUDIO TRANSFORMERS**

MODEL #	PRIMARY IMPEDANCE (ohms)	SECONDARY IMPEDANCE (ohms)	NO. OF SECONDARY WINDINGS	REF. 600 OHMS POWER LEVEL
MI-75	18.75/75	150/600	1	+18
MI-46	18.75/75	150/600	1	+30
MI-12	150/600	150/600	1	+18
MI-18	150/600	150/600	1	+30
MI-43	150/600	600	2	+18
MI-44	150/600	600	2	+30
MI-8	150/600	600	4	-10
MI-88	150/600	600	1	+4
MI-102	150/600	5K	1	-10
MI-103	150/600	5K	1	+18
MI-104	150/600	5K	1	+30
MI-5	150/600	15K	1	-10
MI-85	150/600	15K	1	+4
MI-9	150/600	15K	1	+18
MI-15	150/600	15K	1	+30
MI-13	3.75K/15K	15K/60K	1	+18
MI-19	3.75K/15K	15K/60K	1	+30
MI-32	15K	15K/60K	1	-10
MI-95	15K	15K/60K	1	+18
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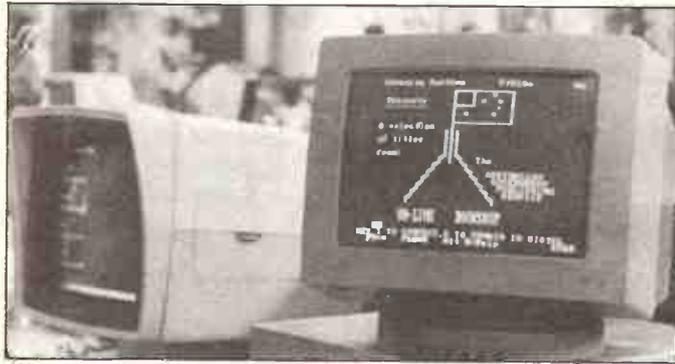
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## **AGPS on Viatel**

The Australian Government Publishing Service is to use Viatel, Telecom's national database, to publish government reports and its catalogue of publications.

AGPS has around 400 different titles in stock and publishes a great deal that is of value for the agricultural, legal, commercial and financial communities, which could be much better served by this new system. Many of the AGPS publications must be frequently updated, for example, legislation. Initially, the AGPS will list 300 to 400 titles it has in print, but it hopes to expand this to list more of the 20,000 government publications as it assesses demand.

The move into electronic publishing was the result of a joint venture by AGPS, the Government's publisher, and the Canberra computer soft-

ware firm, Priority Systems Pty Ltd.

According to Stewart West, Minister for Administrative Services, "Many of the 3500 publications the Australian Government Publishing Service puts out each year are highly specialised and are of particular value to small target audiences. Viatel could be one way of informing these audiences of the availability of reports of interest."

One of the interesting features of the AGPS service is to provide access via a key word search or by category. The service captures all unsuccessful attempts with key words which will enable it to tailor the service to user demands.

The AGPS service is listed under service provider "Priority Systems" and can be accessed on Viatel page 5721.

## **Integrating Voice and Data Wins TI Award**

A new system of integrating voice and data communications has won a young University of New South Wales student one of the first Texas Instruments Technology Awards.

Tiong Lee Ng won the award for his innovation of a system to more efficiently utilise voice and data channels.

Tiong was concerned at the pressures mounting on lines for both voice and data communications and at the development of local area networks (LANs) as a means of trying to solve the problem. LANs, while employing a relatively high bit rate communication, require random queuing delays which degrades performance of real-time communications. This means that traditional LANs such as Ethernet are incapable of high performance for voice communications.

Early attempts to integrate voice into such traditional LANs resulted in systems with poor utilisation and excessive voice delays and losses.

Tiong used the IBM Token Ring LAN to devise a protocol which efficiently intergrates voice and data communications. This includes the use of



speech interpolation to increase the channel utilisation of the network and the playback technique used to overcome the problems generally associated with voice communications in packet-switched networks.

He based the network software architecture on the seven-layered International Standard Organisation's Open System Interconnection (OSI) references model, and IEEE LAN standards.

A multi-tasking system, called NET-OS was developed to support these processes.

Texas Instruments' Managing Director, Stuart McNair, said the creation of the NET-OS was a significant development for Australian technology and was an excellent example of the reason Texas Instruments created the Technology Awards.

"Our future lies with these young people in higher education institutions," he said. "Their innovation and creativity will provide a firm basis for Australia's future."

## **Frequency**

impossible to detect data traffic without listening in to subscribers calls. In all probability the majority of readers of this magazine could design a circuit to recognise a modem at the drop of a hat.

Indeed the idea of singling out data traffic and making special paying arrangements for them is so obvious that one wonders what the problem is for Telecom management. Is there some hidden agenda here as the Australian Telecommunication Employees Association would have us believe?

It may well be that part of the strategy is to increase Telecom revenue. In spite of large 'profits', major investments in new technology will be required before the turn of the century. It may also be that this is a move in the wider privatisation debate. However, the fundamental reason is likely to be more prosaic. The commission is surely not out to kill the goose that laid the golden egg. Data communications is the most dynamic

growth area in telephone usage at the moment. Most of the plans for expansion of the network, and the introduction of new technology are based on the needs of data traffic. The last thing Telecom wants to do is hit data users with price increases.

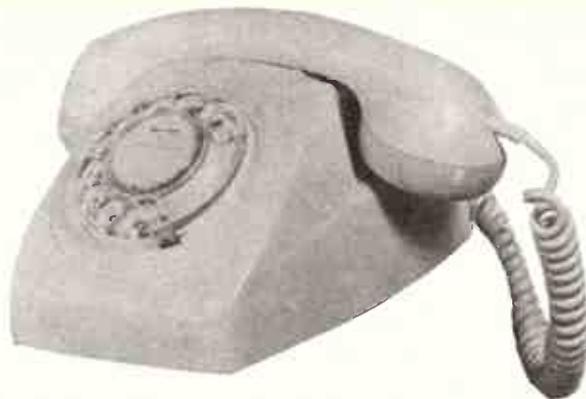
However, timed price calls for data communications might not necessarily have that effect if the prices were set at the right level. Indeed, the converse might well be true. Making data users pay the economic cost of using the network would soon convince all but the most obtuse user of the advantage of high transfer rates. It would work against bulletin boards and other "browse" type uses, but that might well be a software problem that given the right financial encouragement, could be solved rather easily. Timed calls would see a massive increase in demand for the new generation of high speed modems, and that, in turn, would be excellent news for the modem industry.

## Deafnet

One of the greatest drawbacks of being deaf is being unable to use the telephone. Now a company in the US, Bell Communications Research in New Jersey, is testing a prototype "Telecommunications Network for the Deaf" or "Deafnet" which would let the deaf communicate with people having normal hearing over the phone system.

Deafnet takes advantage of recent developments in speech synthesis and recognition. The deaf person enters words into the system by typing on a special keyboard, which is the standard American telecommunications device for deaf people.

The keyboard is part of a small on-line terminal. The system would recognise the typed signals and convert them into synthesised speech for transmission to a standard telephone. Responses from the hearing person on the other end would be transmitted over



phone lines to a computer system in the telephone switching office, which would convert spoken words or responses on push-button phones into codes displayed on the deaf person's terminal.

Deaf users will make direct calls to hearing people without

special equipment. They will respond to, and ask, questions by pressing buttons on the telephone keypad. The deaf person would type words on their terminal to ask yes-no or multiple-choice questions.

The system would synthesise speech from the entries, and the hearing person would respond to the synthesised voice by pushing buttons on their phone (for example, one for yeas, two for no).

Speech recognition is a long-term goal, because it involves tougher technical problems that would limit its use to frequent callers. The system must be "trained" to understand individual speakers by listening repeatedly to their voices, as transmitted by the telephone system.

## Electrical and Electronic Industry Training

Funding for a new South Australian Industry Training Committee (ITC) in the electrical and electronic industries has been announced by the Minister for Employment, Education and Training, Mr John Dawkins.

Mr Dawkins said the Commonwealth Government would provide \$55,000 during the first year of the ITC's operation and a further \$10,000 would come

from industry.

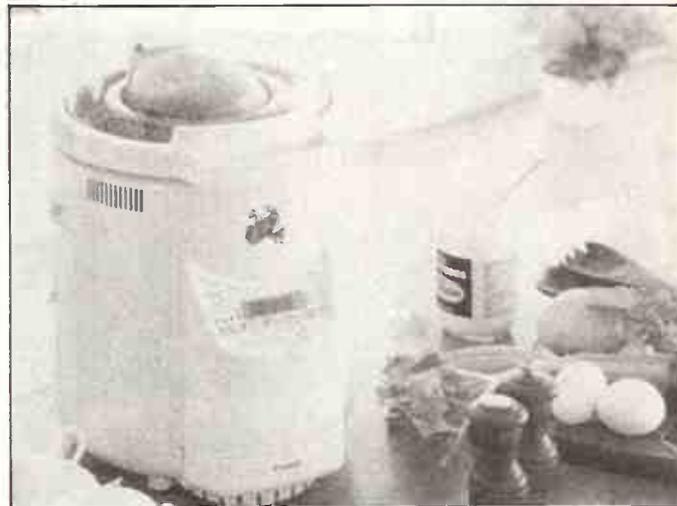
The new Electrical and Electronic ITC is made up of representatives of industry, State and Federal governments, and unions. It will promote and develop training advice to government. The ITC will merge with the existing Training Advisory/Curriculum Committee, established under State legislation, to avoid duplication in providing government policy advice.

## Ultralights

International interest in Australian aircraft seems to be rising with the recent announcement by Thruster Aircraft Australia of two sales of its Gemini Ultralight to the Nepalese army. The aircraft in question is a two seater and is powered by a 60 horsepower Rotax engine, it has a wingspan of 9.6 metres and can cruise at 65 knots. As befits an ultralight the craft weighs only 160 kilograms. Most importantly it

costs only 20,000 dollars.

The cheap cost of the ultralight has interested a number of outer countries in the aircraft. These include Japan, Fiji and Thailand. Altogether Thruster aircraft expect to export no less than 200 of the aircraft this financial year. The planes have a variety of uses. In Australia they have been used for sheep mustering but they also lend themselves to pilot training and spotting.



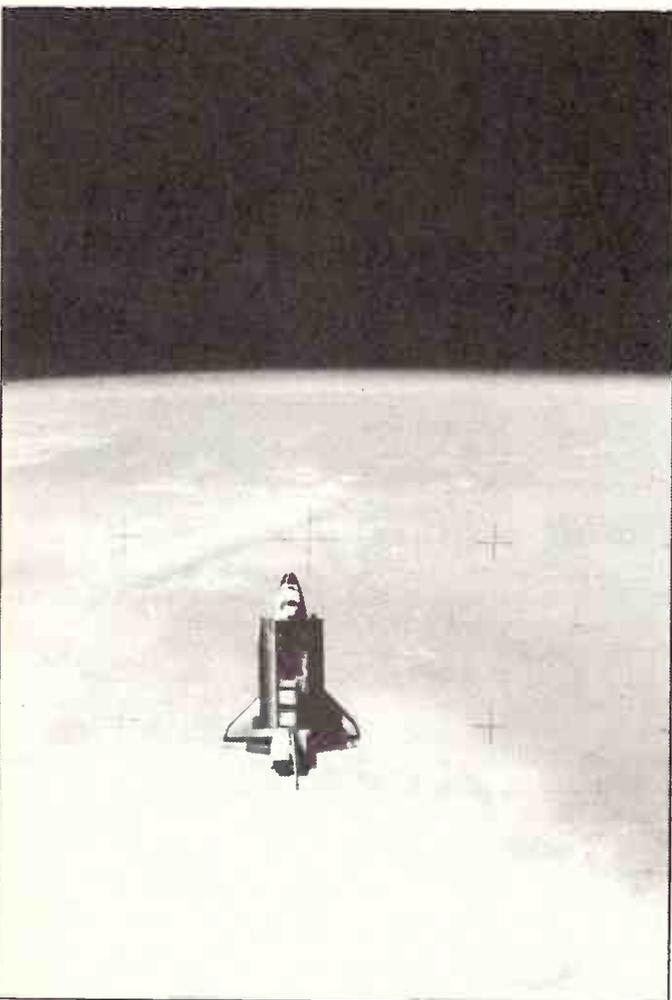
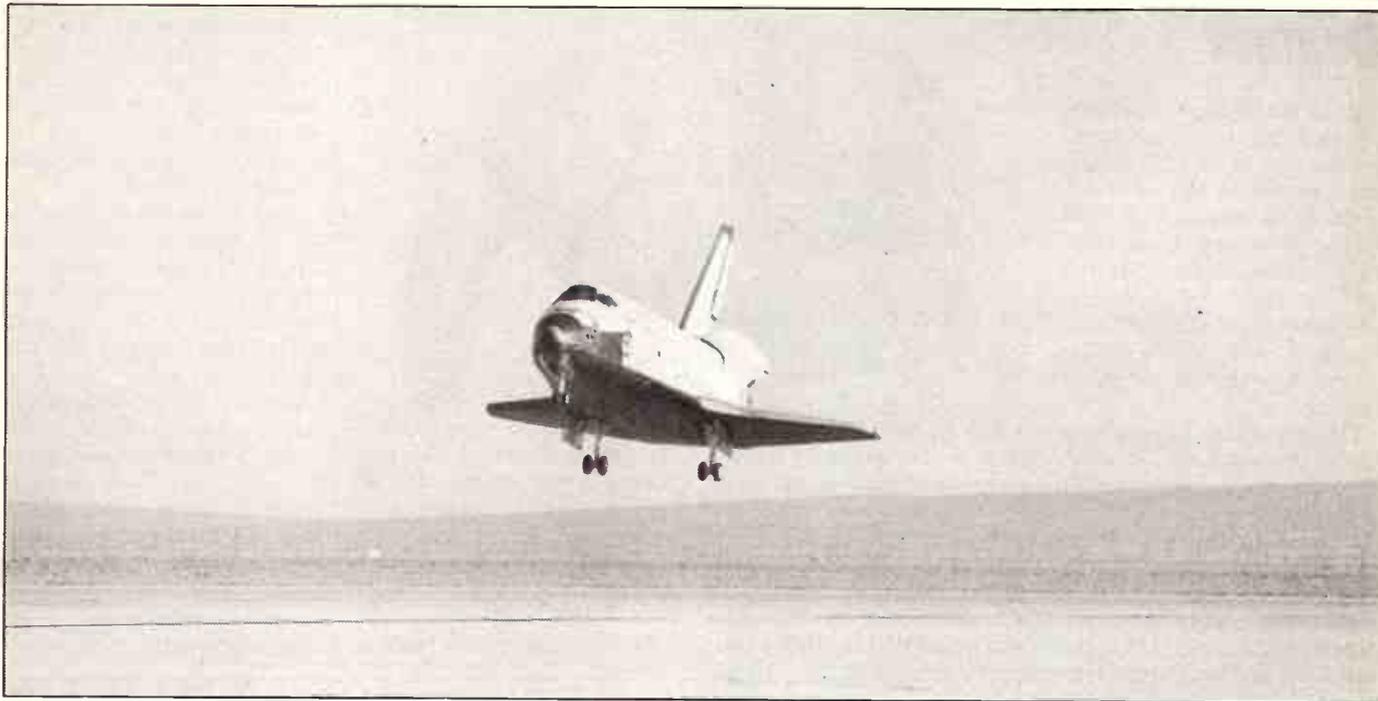
## Home Bakeries

The latest consumer craze to hit Japan is the home baking unit. Basically this is a machine that is designed to automatically make bread from kneading to leavening to baking.

Sales of the units began last year and all the big electronics companies have released various models. By October Panasonic had sold some 400,000 units in Japan alone and it, together with the other companies, are all ready to begin exports to the US and Europe. The success of the automatic bakeries comes as something of

a surprise since large scale consumption of bread is a relatively new trend in Japan.

There is some trepidation however whether the device will take off in the US and Europe. In the first place the loaves baked by the automatic bakeries are relatively small, secondly the appliances are fairly expensive at \$300 (US) per bakery. The Japanese companies are pinning their hopes on the fact that the bread in these units tastes so good that consumers will be induced to overcome their scruples.



## Shuttle Increases Weight

NASA has announced an increase of the allowable end-of-mission landing weight for Space Shuttle orbiters. The allowable landing increase to 230,000 pounds from the previous limit of 211,000 pounds has been made possible by an ongoing structural analysis and additional review of forces encountered by the orbiter during manoeuvres shortly before landing.

Rear Admiral Richard H. Truly, associate administrator for space flight, said: "The total Space Shuttle performance capability requires a balance between lift capacity to orbit and the allowable return weight during re-entry and landing. This new capability will improve this balance and add considerable flexibility and efficiency to our Space Transportation System.

"Our initial analysis indicates that this change will allow the Space Shuttle to carry a cumulative weight in excess of 100,000 pounds of additional payloads into orbit through 1993. The additional down-weight capability also will pro-

vide an important balance between delivery and return cargoes at the Space Station orbit of 220 nautical miles," Truly added.

One potential change, being assessed by NASA to take advantage of this new capability, is the possibility of flying all Spacelab missions on the Columbia spacecraft. This approach would allow configuring Columbia for increased on-orbit stay time and allow optimum use of the Discovery and Atlantis spacecraft, both of which have greater ascent life capability.

Although this capability is effective immediately, only certain flights on the Shuttle manifest have been limited by the landing weight constraint. The first flight planned to take advantage of this increased Shuttle capability is STS-32, presently scheduled to fly the ASTRO-1 mission in the summer of 1989. Additional payloads to be added to this and other missions are being assessed and will be assigned when the next edition of the Shuttle manifest is issued.

# What's the greatest threat facing the computer today?

Australian and American experts agree on what it is, although their estimates of how much it costs you in downtime varies. Americans believe it accounts for more than 30% of all computer failures. Yet some Australians say their practical experience leads them to believe 70% would be a far more accurate figure.

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## Cape York

Part 2 of a feasibility study into the Cape York Space Port has been prepared by the National Committee on Space Engineering of the Institution of Engineers, Australia. This section of the feasibility study considered legal, infrastructure and environmental, management, economic impacts, commercial opportunities and included the following recommendations:

- The two most suitable sites for the spaceport are in the Andoom area to the north of Weipa and in an area to the south of Skardon River (about 100kms further north)
- The preferred spaceport sites lie in areas assigned for mining, enhancing the chances of the site being environmentally acceptable.
- There are no national parks, environmental parks, fauna refuges or reserves within the investigation area
- The construction and operation phases will generate an impact on the economy, but will

be limited without growth of related industries

- The net economic value of the spaceport alone would not appear to justify major injections of public funds without the growth of associated industries
- Between 1989-2001, the market for launch services for non-military western satellites will be sufficient to support between 19 and 32 launches per year, generating a total revenue to the launch vehicle supplier of between US\$11,600m and \$20,500m and 25 per cent of this market could be launched from Cape York, providing an estimated US\$1.5m to \$5m per launch
- Construction and operation of the spaceport will bring into play Australia's obligations pursuant to the five United Nations space treaties, but principally the Outer Space Treaty, the Liability Convention and the Registration Convention.
- Submissions be made to De-



partment of Industry, Technology and Commerce to develop a specific offsets policy directed to the spaceport's development

- The proposed framework for the spaceport should afford in-

vestors the opportunity to maximise use of the spaceport as a base for developing commercial opportunities not necessarily directly related to the spaceport itself, but with associated technology.

## Computers And Poison

Worried doctors in casualty departments may soon be able to turn to a computer for help when confronted with a young child who may have swallowed some type of poisonous substance found around the home. In return for the sketchiest details of the bottle or packet, the computer will be able to give the doctor a list of poisons that the substance may contain, how harmful they are, and what the treatment is.

Staff at three hospitals in and around London are about to begin testing a pilot version of an expert system on poisoning in children developed by scientists at the University of Surrey and Guy's Hospital in London.

The data on which the expert system is based come from a book written by Glyn Volans, director of the Poisons Unit at Guy's Hospital. Last year, the unit's highly trained information officers dealt with more than 52,000 inquiries about

potential or suspected poisoning, just under half of which concerned children under five. Most of the substances relating to this category of poisoning were either "household products" or medicines.

Vivian Johnson and Harley Quilliam of the computing unit at the University of Surrey worked out that if they concentrated on providing information on the 100 most common toxic substances young children take, an expert system would be able to satisfy 85 per cent of inquiries to the Poisons Act. The ultimate aim is to provide all casualty departments with personal computers equipped with a regularly updated program which would advise doctors on common poisons.

A frequent problem with suspected poisoning in children is that accurate details of what the child has taken are hard to come by. In cases such as these, the computer would be



able to list a variety of substances commonly packaged in blue bottles — bleach or toilet cleaners, for example — and confirm details such as their colour, shape and other features.

The computer also asks the doctor questions about features such as whether the substance was a liquid or a solid, and about its smell and, perhaps, taste. If the label on the container is torn or obliterated so that only a few characters from the middle of the name remain — "ara" for example — the computer would suggest possible names for the substance. In this case, one of the names it would come up with would be paracetamol. The program should allow the machine to

identify each of the top 100 substances from such details, the computer then decides which substance fits best with the details provided.

Once the doctor and the computer have identified the substance to their joint satisfaction, the computer asks for details of the child's age, weight and sex. It then provides information on the kind of symptoms that the patient should be experiencing, and warns the doctor if the reported symptoms are different.

Next, the computer gives the detailed advice on the type of treatment to give. At any point, the doctor can ask for references to back up the advice or information that the computer comes up with. The computer also produces a print-out of the case to go in the patient's notes. In addition, it stores the details of the inquiry in order to build up statistics on poisoning in children.

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## New Look

A contract recently signed in Canberra means that Australians will soon have a new and colourful way to look at their country's vital statistics. Under the contract, a mountain of information produced from the last two nation-wide censuses will go onto a compact disc in product called CDATA 86.

This means that the 1981 and 1986 census information, which covers everything from housing to income levels in every corner of Australia, can be displayed on a microcomputer screen in seconds.

Characteristics of the population can be mapped in colour so that the map of suburban Sydney, for example, can show income or age groupings in different colours. The amount of information on the disc would require a 20 metre stack of A4 sized paper in a conventional storage system.

The agreement signed today is between the Australian Bureau of Statistics and a Melbourne based high technology firm, Space Time Research Pty Ltd. It covers the production of the CDATA 86 compact disk and an associated software package, SUPERMAP. The



SUPERMAP software provides both an easy way to use interface to the data and facilities for data manipulation and mapping. The CDATA 86 package will be distributed and sold by both the ABS and Space-Time Research. It can be run on an IBM compatible PC with an attached CD-ROM reader.

"This means that people from town planners to government policy advisers to retail chains can get an instant insight into Australian population profiles and the changes that have taken place in the last five years.

"The wealth of information in the Census data and the speed and efficiency of the SUPERMAP software provides a powerful planning tool."

The ABS research shows that CDATA 86 will be particularly useful for:

- retailers to look at potential store sites based on population trends and household incomes;
- banking and finance institutions to establish where to market financial packages aimed at specific income groups;
- manufacturers to look at the location of markets for products aimed at market segments (the middle aged, teenagers, people with specific incomes, or from specific professions);
- local Government planners and consultants to examine population trends affecting the provision of services;
- State and Federal Government planning authorities to examine the factors which affect roads, transport, welfare and construction planning;
- Universities and Colleges of Advanced Education for teaching and research projects.

Mr Castles said from the ABS point of view, CDATA 86 meant that the Census data would be accessible to more people more easily.

Under the agreement signed today, the CDATA 86 product will be released in February next year.

## World Total

IN ITS annual forecast of the world electronics market, the Electronic Industries Association recently predicted the dollar volume will have expanded to US\$413 billion in 1987, up 7 per cent over 1986's total of US\$386 billion. In addition, total sales will reach US\$500 billion by 1990, representing an average annual growth rate of 6.6 per cent, EIA reported.

Consumption of electronics in the US represented almost 50 per cent of the total world electronics market last year for a total of \$189 billion. Present numbers indicate the 1987 figure topped \$200 billion or a 6 per cent increase over last year, the EAI forecast said. The forecast identified the three largest electronic market segments as electronic components (25 per cent), data processing equipment (22 per cent), and communications equipment (15 per cent). The association predicted the components market will reach US\$120 billion by 1990 with an average growth of 6.8 per cent. Communications, however, will make only "moderate gains" at about 4.5 per cent annually, and defence electronics sales will be flat until 1991 because of limited expenditures expected for defence and R&D.

"We believe the concern about the continuing national debt and trade balance problems and the changing nature of Congress — which is showing increasing concern over domestic matters — will affect defence budgets more than any perceived chance in the character of the threat," the report said. 25 years ago, defence spending was twice that of domestic entitlements and other mandatory spending, according to the report. Within 10 years, EIA says, that ratio will be reversed.

Another factor, according to the report, deals with "efficiency in the so-called military/industrial complex". Emphasis on second-sourcing and

teaming seems to have left more defence contractors with a reluctance to share their technological expertise. The result, EIA states, is less capable products for the dollars spent.

In summing up, the report concludes that defence spending as a share of both gross national product and federal expenditures will continue to decline, bottoming out in approximately 10 years to the relative levels seen in the middle of the Carter administration.

## Publishers Adopt CD-ROM

British publisher, Robert Maxwell, recently bought a majority share in record company, Nimbus, giving him access to equipment to manufacture CD-ROMs. While common compact audio discs are produced in hundreds of thousands, production runs of CD read-only memory discs are much smaller (usually less than 100) yet each run must be mastered in the same way as a CD, delaying production and adding extra expense. CD-ROMs too, often contain material that must be updated frequently, so any improved access to mastering equipment is welcomed by publishers.

In a far-reaching investment, Nimbus developed its own mastering equipment (for a reported £150,000), which won it the Queen's Award for Technology last year. The machine works using a high precision turntable with a powerful laser that cuts a spiral track of data pits into a glass disc. The disc is then electroplated to produce stampers of the mass production presses to use for either CD-ROM data or music discs.

While Robert Maxwell hasn't given details of what he plans to publish on CD-ROM, Whitaker has announced a service to booksellers that lists all the books currently in print, updated on a CD-ROM monthly.

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## Report on Sub-Millimetre Technology

The Department of Industry, Technology and Commerce, has released a report giving an overview of Australian capabilities and opportunities in the emerging field of millimetre and sub-millimetre (MSM) wave technology.

The report, a working paper aimed at stimulating further discussion of the subject by people in industry, academia and Government, looks at MSM wave technology as an area with significant potential for Australian industry.

Fibre optics and microwaves are widespread in communication technology. However millimetre and sub-millimetre waves have only recently been widely exploited, despite the fact that they were first used last century.

MSM covers radiation of wavelengths from about

0.05 mm to 15 mm, or, in terms of frequency, about 6000 GHz down to about 20 GHz. This covers the spectrum from high frequency microwaves to the far-infrared and infrared. In the sub-millimetre range the wavelength is so small that many conventional microwave techniques are no longer useful.

Both traditional microwave and infrared are areas of extensive research and industrial activity both in Australia and abroad.

MSM has a wide range of applications including sensors for military, meteorological and navigational applications; communications; diagnosis of ionised gases/plasmas; astronomy; and molecular spectroscopy among other things.

The advantages of MSM over both traditional microwave and

infrared (IR) radiation are many. It has a broader bandwidth than traditional microwave; as well as this, millimetre waves can penetrate clouds, smoke, dust and fog more effectively than IR radiation; there is considerable spectrum space available for atmospheric propagation compared to lower frequencies; and MSM spectroscopy is complementary to IR spectroscopy. It is particularly useful in the study and characterisation of solid state systems and large molecules.

There are about 60 R&D researchers working on millimetre and sub-millimetre wave technology in Australia, in about 18 establishments, including universities; CSIRO; Telecom research; and Defence research. Unfortunately, the scale of private sector MSM R&D in Australia is almost

non-existent.

According to report author, Dr E. Cawthron, MSM R&D output is not being commercialised, possibly because it is a field with a strong science bias, and scientists in Australia have traditionally been less market oriented than their engineering counterparts.

However, the MSM R&D community could supply a potential market with innovative products such as filters, receivers, detectors, gratings, sources and mixers, (solid state) tunnel junctions, grids, lenses, interferometric systems, sub-millimetre laser systems and gyrotron systems.

Copies of the report can be obtained from the Materials Technology Section, Department of Industry, Technology and Commerce Canberra, ACT, (062) 64-4334.

## Clayton Exporting to Canada

Philips Clayton factory is set to export its FM9010 cellular radio car phone to Canada. Canada recently gave approval to the type of cellular radio phone made by Philips at Clayton and samples have been received by Philips in Canada which expects wide distribution for the mobile phones.

The development of the FM9010 by a joint Australian-Danish team was prompted when Telecom Australia announced in 1985, that its choice for the new cellular radio phone system would be the North American AMPS (Automatic Mobile Phone Service) and tenders were called for the supply of phones to operate on this system.

Philips, not having a product to the AMPS specification, commenced new electronic design work at the Clayton plant in Victoria, drawing on the company's European experience in cellular radio. Following this a small team of Austra-

lian engineers went to Philips Denmark, to further the design.

Philips won a Telecom contract and now supplies one version of the FM9000 series, marketed as the Telecom 'Traveller'. Meanwhile, the Clayton plant was refitted with surface-mount device equipment and by the end of the first quarter of 1986 — only two years after the initial proposal — the Clayton plant started manufacturing cellular phones. The original design team was brought back to Victoria to provide support for the product.

Last year, Philips made the Clayton plant an 'International Product Supply Centre', which means that it is now responsible for the design and manufacture of all AMPS-compatible phones made by Philips worldwide. As the AMPS system is used in Canada, Hong Kong, the USA and New Zealand, this opens a vast potential market for the Australian product.





Britain's Space Minister, Kenneth Clarke.

## Bickering in ESA

According to a recent report, Britain's Space Minister, Kenneth Clarke, has vetoed any increase of funds for the European Space Agency and postponed Britain's involvement in any major space programmes. He is demanding greater consultation with industry and users (despite a 12-volume report on industry and academic views commissioned by the British government) and greater financial contributions from industry.

ESA's plans include Ariane 5, a powerful new rocket for the 1990s, Columbus, Europe's contribution to the US space station, and space plane Hermes which Ariane 5 will launch and which will carry astronauts. Clarke's objection to the projects is that they will tie up all funds for the next 20 years. His decisions about the Columbus project depend as yet on a US-Europe agreement. Mostly, he objects to Hermes which he described as "a cuckoo in the nest that is in danger of pushing everything else out". "Everything else" it has been speculated, is Britain's space plane Hotel by some French ESA delegates.

Clarke's decision has been lamented by industry. Said spokesman Don Hardy, "We see doors being closed to future technological advance and exploration of space". Apparently, Britain jeopardises contracts to local industry by opting out of Columbus. Britain has been committed to 13 per cent of the development cost, contracts for which would have been awarded in Britain.

## Motor Uses S'conductor

Researchers at the Argonne National Laboratory in the US have built the first electric motor based on high-temperature superconductors. Its first public showing was in February at the annual meeting of the American Association for the Advancement of Science in Boston.

It is called the Meissner motor and revolves at 50 times a minute. The motor operates by the Meissner effect, through which superconductors repel magnets. "It's the same repulsion you feel when you push north poles of two magnets together," said Roger Peoppel at Argonne.

Peoppel emphasises that the motor is experimental only and produces "negligible power".

The motor consists of a 20-centimetre aluminium plate

with small electromagnets mounted along the bottom of the outer edge. The plate rotates above two discs made of yttrium-barium-copper oxide, which becomes a superconductor at about 94 K. The repulsion between the electromagnets and the superconductor spins the plate.

## British Digital Two-way Radio

The first working demonstrations of a new British digital radio communications system is expected to be demonstrated towards the middle of the year. The new Private Advanced Radio System (PARS) was developed by the British Electronic Engineering Association (EEA), with some connivance from the Department of Trade and Industry, to challenge the

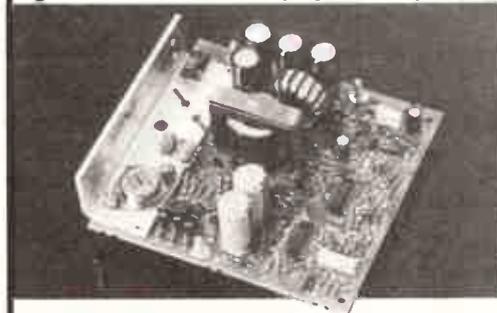
Japanese system Personal Radio System (PRS) after that system's successful introduction in Switzerland.

PARS is a point-to-point service transmitting speech as digital code and broadcasting at low power on the 80-channel UHF band. Like PRS, it is a simplex system with a control channel indicating free frequencies. Individual transceivers scan this channel and lock onto an available frequency when it is available.

PARS works only over a 5 kilometre range but in Britain its appeal will lie in the fact that users won't require licences and the system won't need a network control system to be paid for by users. Transceivers are expected to cost a few hundred pounds and to appeal to taxis, local delivery services and repair services.

The British Department of Trade and Industry has blocked Japanese imports until 1990 to give the new system a go.

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## Computer Course

A new technology-related course that emphasises the link between management and computers and other high-tech areas previously shrouded in the mystery of the 'back room', has been instituted at The Frankston College of TAFE in Melbourne.

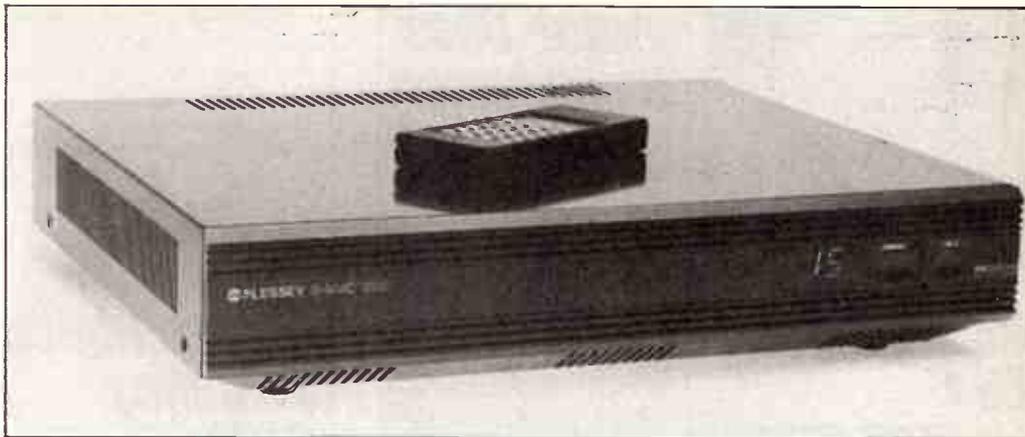
The course title is the Associate Diploma in Technology (Computing), ADTC and is designed to cater to those people who have been away from study for some time, or perhaps sat the wrong HSC stream. A bridging program is also offered to help people brush up their study and communication skills before the start of the course proper. Mature age returning students are well catered for.

There is also the option of transferring to the Bachelor of Technology degree course at either the Frankston or Caulfield campuses of Chisom Institute of Technology after completing the first year of the ADTC.

For further information contact Sue La Fontaine, Information Centre, Frankston College of TAFE, Railway Pde. Frankston, Vic 3199, (03) 784-8222.

## Townsville Radio Shuffle

The Townsville Amateur Radio Club has announced its new office bearers. New President is Evelyn Bahr, VK4EO. Secretary is John Stevens, VK4AFS, and Treasurer is Ian Sutton, VK4ZT. For a full list of positions filled as a result of the annual general meeting and the annual report, contact Peter Renton, VK4PV, Publicity Officer on (077) 81-4734 (b) (077) 72-1236 (h).



Plessey satellite decoding and station descrambling equipment, familiar to many outback Australian viewers.

## Scrambled BBC

The BBC is currently testing a system of encoding programme material which can only be received and unscrambled by modified video recorders. The system is initially intended to earn the BBC extra revenue by the broadcast of medical programmes for doctors. Ultimately it hopes to transmit more lucrative encoded material such as feature films. Viewers would pay a subscription as well as a fee for their li-

cence and the cost of their descrambling equipment.

As from March, British Medical Television will disseminate its programmes via the BBC. For their subscription fee, doctors will get a flat mat which sits under their recorders and senses the beginning of a scrambled transmission and descrambles. The mat emits an infrared pulse which activates the video.

Scrambled TV signals are

not new to Australia. In fact, it is entrenched in the Government's TV equalisation programme to regional areas. All satellite broadcasts to Australia's outback areas are encoded, apart from ABC transmissions and SBS transmissions. SBS was encoded (with much protest) until the end of last year. Viewers of commercial satellite transmissions need a dish, satellite decoding equipment and descrambling devices.

## Yukawa Terms

Researchers at the University of Queensland have given support to the idea of a non-Newtonian component of gravity which they suggest might be the difference between two much larger forces, one of repulsion and one of attraction.

In experiments reported in *Physical Review D*, vol 36, p2374, Frank Stacey and colleagues at University of Qld measured gravitational attraction at the top and bottom of a mine shaft. They found that at these distances gravitational attraction is very slightly less than Newton's law requires. Newton's law requires that the force of attraction between two objects is inversely proportional to the square of the distance between them.

One explanation of the

anomaly is that a fifth force besides gravity, electromagnetism, and strong and weak nuclear attraction, operates. Such a force has been called a "Yukawa term" force and has been described in *New Scientist* as a small repulsive force which falls off exponentially over a few hundred metres.

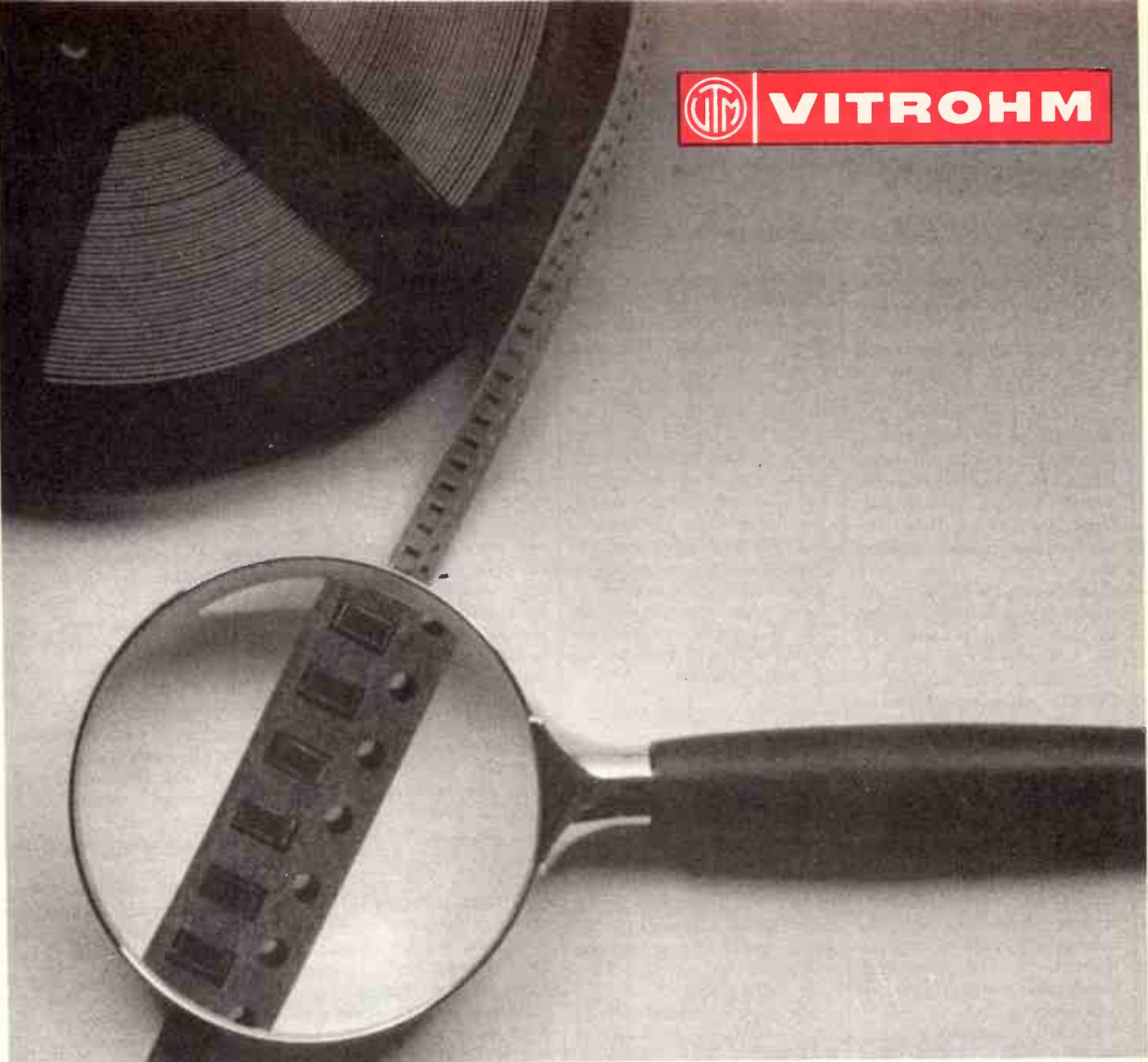
According to Stacey and his researchers, there are good theoretical reasons for believing these Yukawa terms always come in pairs which have opposite signs. Their measurements are consistent with Newton's law if two Yukawa terms always come in pairs which have opposite signs, representing a repulsive force and an attractive force, each with short range. As long as the difference between the two terms is

small, each of these forces can be quite large, roughly as big as the familiar Newtonian force.

The team compared this new theoretical description of gravity with large-scale observations over the Solar System, their own geophysical data, and laboratory tests. According to the researchers both the Yukawa terms have ranges up to 450m kilometres and the repulsive force may be stronger than the attractive force by the equivalent of about 1 per cent of the gravitational constant used in the Newtonian model. The range of the repulsive force is slightly less than that of the attractive force. Each "new" force is, at short range, as strong as gravity.



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## Observatory Progresses

Work is gathering momentum on the WM Keck Observatory, in Hawaii. US firm Tek Optical Systems recently cut the first of the observatory's hexagonal mirrors. 36 of these will be linked in a honeycomb pattern to form an area equivalent to a single 10 metre wide mirror. The resulting mirror will gather four times as much light as the largest working optical telescope, the 508 cm Hale telescope at Mt Palomar, California.

At present, the telescope, sitting atop the dormant volcano of Mauna Kea is waiting for the telescope frame which is scheduled to be installed in October. Astronomers expect to view first light in January 1990.

## Future of MIC Program

The Minister for Industry, Technology and Commerce, Senator John Button, has announced the extension of the Management and Investment Companies (MIC) program until June 30, 1989.

The MIC Program was introduced in early 1984 to help develop a much needed venture capital market in Australia.

The future of the program beyond that will be decided in the course of the review of business taxation announced by the Treasurer in the last budget and should be announced before or in the 1988-1989 budget.

To date the MICs have invested almost \$100 million in 104 Australian businesses across a range of industries, including computer software and hardware, electronic equipment and medical equipment.

The program has been a catalyst to the generation of a fast-growing domestic venture capital market. Senator Button said the review by the Bureau

of Industry Economics into the venture capital market in Australia had shown that, since the inception of the MIC Program in 1984, there had been a considerable expansion in the availability of venture capital and in the extent of management support for innovative businesses.

Senator Button also announced that the MIC Act would be amended to permit MICs to raise non-tax-concessional capital in conjunction with tax-concessional capital. The Act will also be amended to enable an MIC to leave the program without triggering the tax clawback arrangement.

The upper limit of \$20 million in revenue foregone per annum will be retained for the life of the program.

## Silicon Harbour

A highly advanced three-storey electronics plant (of over 29,000 square metres will soon occupy a 7.2 acre site in the high technology zone of the Tai Po Industrial Estate on the waterfront next to Tolo Harbour in Hong Kong.

The project is called "Silicon Harbour" providing a clue to the products to be designed, manufactured and tested at the new facility namely, semiconductors utilising computer-aided-design/manufacturing/integrated-manufacturing (CAD/CAM/CIM) technologies. By 1990 when the building is completed these technologies will not only represent the "state of the art" in the Hong Kong semiconductor industry but will also be one generation ahead of similar facilities now in the USA and Europe. The emphasis is on producing high quality semiconductors of increasing complexity at the shortest possible cycle time. The project will also help the local electronics industry to move into the current generation of modern circuitry and product miniaturisation.

The plant will accommodate Motorola's Asia Pacific Division Headquarters, regional computer centre, design and manufacturing centre for ASIC, bipolar/MOS LSI semiconductor.

Hong Kong had been chosen as the location for US Company Motorola's "Silicon Harbour" project mainly because of its advanced infra-structure support especially in areas such as telecommunications and computers. As well as this there is the company's own strong professional, technical and management team which has been built up during its 20 years' operation in the territory. The company were also impressed with other favourable factors such as stable Government and low tax rates.

Motorola's new facility in Tai Po Industrial Estate will provide a strategic tool to help penetrate the China market, while the proximity of Hong Kong to China and the common language and culture are also seen as definite advantages.

Motorola, a major US-based electronic company, started its operations in Hong Kong in 1967. During 1982, Motorola Semiconductor inaugurated a multi-million dollar facility in Kwai Fong to house its Asia Pacific Headquarters, production/test centre and engineering laboratories. A fully automated integrated circuit assembly centre which is a more recent development started operations a few months ago.

## High-tech City

The Government is to participate in a major study to determine the feasibility of establishing an international high-technology city, or "Multi-function Polis", in Australia.

The study will be jointly coordinated by the Department of Industry, Technology and Commerce and the Japanese Ministry of International Trade and Industry.

The findings will then be



Minister Jones.

considered by both the Japanese and Australian Governments for a decision on whether to proceed.

Acting Minister for DITAC, Barry Jones, said that the concept envisaged the creation of a new urban complex based on industries, technology and leisure which would be increasingly important in the 21st century and in which Australia already had expertise.

Such industries could include biotechnology, computer software, new metals and rare earths, education, health and tourism.

Mr Jones said that during 1988 there would be extensive consultations with State Governments, the private sector and community interest groups on the question of location, scale, funding and composition of the population of the city.

He emphasised that the city was intended to be international in concept, involving the participation of both Pacific Rim and European countries. As such, it could become a centre for cultural, educational and technological exchange.

The financial viability of the concept would depend on the response of the private sector in Australia, Japan and other participating countries since it was envisaged that the project would be funded through private investment.

The Federal Government would, however, share 50 per cent of the cost of the feasibility study with State Governments and the private sector. The Japanese side would similarly fund 50 per cent of the cost.



**This month Kilohertz Comment looks at the controversy surrounding Radio New Zealand**

# Kilohertz Comment

## The Pacific's Tin Whistle

In recent weeks the NZ Government has been taken to task for its failure to upgrade the transmitters of Radio New Zealand which at present comprise two 7.5kW transmitters. These have been in service since the beginning of shortwave broadcasting on September 26, 1948.

In the Annual Report of the Broadcasting Corporation of New Zealand the BCNZ commented . . . "Once again a relay of the National Radio Network has been the main programme from Radio New Zealand's shortwave transmitters. . . . There is no substitute however, for a sustained and strong voice for New Zealand in the Pacific . . . In view of the ideological battle being fought out for influence in the region, it is of concern that yet another year has gone by without a clear indication of Government policy and without a level of financial commitment being established to upgrade this vital presentation of New Zealand to the rest of the world".

## Steam Radio

Following the Annual Meeting of the NZ Radio DX League a press release was issued in which the League criticised past and present governments. Newspapers emphasised the lack of action in upgrading the service with such headlines as "NZ lagging behind in radio transmission", "Transmitters concern Radio League", "N.Z. shortwave coverage criticised".

An editorial in the Otago Daily Times, Dunedin NZ had the heading "Steam Radio".

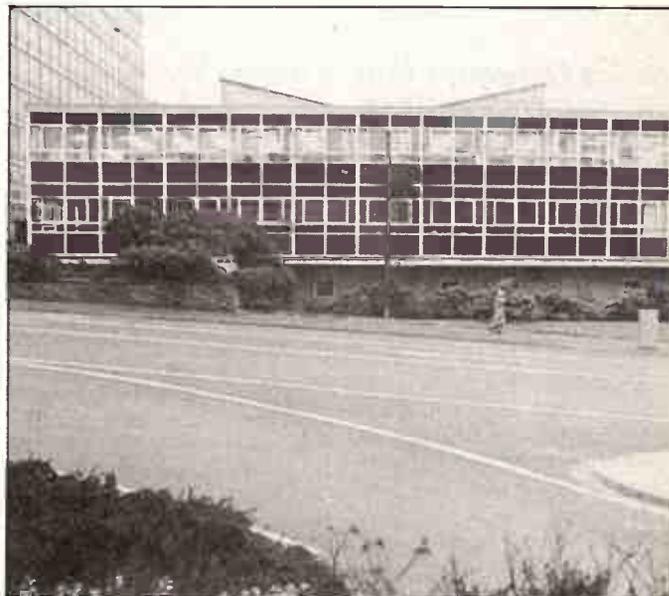
The Government had a Royal Commission on Broadcasting & Communications look at the position of the shortwave service two years ago. The Commission suggested a change of site, higher powered transmitters and that the service should be funded by the Foreign Affairs Department. At the present time the Shortwave Service is subsidised by the BCNZ and runs at no direct cost to the Government. The recently appointed Minister of Broadcasting, Hon Richard Prebble, has assured the writer that his Government will soon make a firm decision one way or another on the future of the service.

The Shortwave Service of Radio New Zealand has the following schedule, which is effective until September 6: 1830-2115 11780, 15150; 2345-0145 11780, 15150; 0345-0730 9540, 11780; 1030-1215 6100, 9540. Saturday only 0145-0345 11780 and 15150. The transmissions are beamed to the Pacific Islands, Australia and Papua New Guinea.

## Shortwaves

ALASKA: KNLS from March 27 to September 24, 1988: English 0800-0900 on 11860; 0900-1000 on 11820, 1000-1100 on 11930; 1730-2030 on 11700 kHz, Mandarin 1100-1230 on 9710 and 1230-1400 on 7355; Japanese 1400-1500 on 9750; Russian 1500-1730 on 9750 and 2030-2300 on 11700.

AUSTRIA: The Austrian Radio from Vienna is heard on 11780 kHz at 0200-0400 UTC. This frequency carries the same programme as on 9585 kHz. The broadcast from Vienna to Australia continues in English 0830-0900 on 15410 kHz.



**Broadcasting House Wellington — The home of Radio NZ's shortwave service**

BRAZIL: Radio Braz opens 0200 with English announcing on 11745 kHz, but drifts to 11748 or 11750 kHz.

KOREA: Radio Korea announces English service when opening at 2330 on 15575; To Europe at 0800 7550 on 13670, at 1800 on 15575 and 2030 on 6480, 15575; American Service 0600 on 6060 on 9570; 1400 on 9750, 15575 and 2330 on 15575; Middle East and Africa 1100 on 15575, 1600 on 9870 and 2030 on 7550; South East Asia at 1400 on 9570. General Service 0600 on 7275 and 1600 on 5975. Each broadcast is one hour in duration.

NEW ZEALAND: Tentative Schedule from May 1: 1830-2115 on 11780, 15150; 0345-0730 on 9540, 11780; 1030-1215 on 6100 and 9540. Saturday only 0145-0345 11780 and 15150.

TURKEY: Ankara is heard very well on 9445 kHz with

English 0400-0450, the same programme on 17760 gives fair reception. The full schedule announced is 2100-2150 7215, 2300-2350 7135, 7160, 9445, 17760 and 0400-0450 9445 and 17760.

U.S.A.: The Voice of America has produced a seventeen page booklet to aid radio listeners. It covers a wide area of subject matter including listening to the VOA, details on relay bases, antennas, propagation and is available free on request from the VOA, Washington DC 20547, U.S.A.

*This item was contributed by Arthur Cushen, 212 Earn St., Invercargill New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 10 hours behind Australian Eastern Standard Time.*



**Paul Budde reports on  
the local and international  
position of Videotex services**

*This item was contributed by  
Paul Budde Communications,  
PO Box 372, Roseville, NSW  
2069.*

READER INFO No. 126

# Videotex News

## **Swiss Gateways Into Bildschirmtext (Btx)**

Btx have introduced TIBSY, a videotex service hosted by Radio Switzerland's DS-VTX system. When called by a Btx terminal, TIBSY, which is run on Radio Switzerland's computer, is considered an external computer (host) on the Btx network.

Designed for both travel agents and private users, TIBSY gives the address and names of all the hotels in Switzerland and has booking facilities for 200 Swiss hotels.

This is the second service hosted by Radio Switzerland that gateways into Btx, following the Swiss Air Service that has been gatewayed since May 1986.

## **Homebanking In Switzerland**

Banks are the most dynamic information suppliers in Switzerland at present. While the leading banks in Switzerland are improving their telebanking services for their customers, the Raiffeisen Mutual Banks have opted for an in-house system. Named Raiffeisen Financial Information Videotex System, the service is accessible as a Closed User Group by the various branches of the Raiffeisen Mutual Bank.

More than 250 branches are connected to the system to date. The bank has chosen Radio TV Steiner's equipment for its service.

## **NEC Readies VAN Service**

NEC has expanded its PC-VAN, a domestic, value-added

network for its dealers in Japan, to all NEC PC series users. NEC included a NAPLPS videotex service to the VAN.

The PC-VAN information providers (IPs) have been pressing for the ability to offer video image information. Videotex can provide versatile images in a short transmission time which personal computers' graphic transmission cannot. NEC is developing NAPLPS interface programs so that NEC PC users can retrieve information provided on videotex from their machines.

The PC-VAN is a private network service targetting over one million users of NEX PC series microcomputers in Japan.

## **Videotex In Brazil**

Since its trial launch in December 1982, the Brazilian videotex service has grown with a total of 32,000 videotex pages and around 303,000 access calls per month. The average number of calls per terminal per month is 110. The total number of users registered in August 1985 was 3,280, of which 1,880 are home users, 840 business users, 48 are public terminals, and 512 are microcomputers.

Commercial activities relating to the videotex service employ over 500 people directly; over 70 companies have developed products and services in this area.

## **HP's Betex Software For Danish Public Videotex Service**

The Betex videotex system, initially designed for Hewlett Packard computers, is in use

with the Danish Telecom Administration (DTA) for its public videotex network (Vicorp). Vicorp will install a videotex management centre (VMC) based on its Betex system that will run on Tandem Computers; Micro Scope (UK) will supply the networking end of the Danish public videotex system with its videotex access points.

## **Shoppers Can Let Their PC's Do The Walking**

Comparel, US, is a specialised electronic data base that helps consumers assess 66 different types of products using a variety of criteria. Articles and products ratings are culled from 13 publications. The key to the service is a US\$29.95 software package that lets consumers work with ratings once they've been called into a computer from the data base. A shopper can rank brands of refrigerators by freezer size, or look at used cars in a specific price range. Consumers are billed only for the amount of information they receive — typically about US\$3 for an article.

## **Supermarkets Stock Instant Line Know-how**

Wine Steward US, sells special computer terminals and software that help customers make the best choice of table wines. Supermarket customers just choose from a list on the computer screen of what kind of meal they are having — "Mexican" or "Italian", for example. The computer monitor then displays a selection of

wines that would best compliment the food, along with a description of each bottle and the price. Each data base is tailored to the specific store. In the US, 58% of all wine is purchased in supermarkets.

## **Panasonic On Videotex**

Panasonic will introduce a new line of videotex hardware for public access, desktop or electronic banking applications. Panasonic seeks joint-ventures with banks to launch such systems this year. The equipment is based on Public Access Videotex (PAV) hardware which Panasonic's parent firm has installed in Japan, including a NAPLPS decoder, videocassette player, magnetic stripe interface and videodisc player.

## **Communication Cost Discourages Videotex Use**

A recent US Link Resources Corp survey showed 71% of videotex subscribers felt the high communication costs could very well be the most significant barrier to the growth of videotex. The high cost detracts greatly from the entertainment factor and discourages exploration and experimentation.

Entitled "Videotex User Survey", the Link Report is the first comprehensive survey by means of commercial videotex services. The questionnaire, which took ten to fifteen minutes to complete, ran for at least one week during April and May last year on The Source, DELPHI, and Play-Net. It was compiled by 383 videotex users.

## COMING EVENTS

### MARCH

**Joint International Symposium on Information Systems** — JSIS 88 will take place from February 19 till March 2. Contact R. Jeffery, Dept of Information Systems, University of New South Wales, PO Box 1, Kensington 2044.

**Communications 88** — the third International Electronic Communications and Information Technology Exhibition will be held at the new Sydney Conference and exhibition centre in Darling Harbour during March. All those interested in this comprehensive exhibition should contact Australian exhibition services Pty Ltd, 424 St Kilda Road, Melbourne, Vic 3004. Tel (03) 267-4500.

**The World In Space** is the name of the 1988 annual convention of the American Congress of Surveying and Mapping/American Society of Photogrammetry and Remote Sensing. Contact Jerome J. Lenczowski, 12755 Weber Hill Road, St Louis MO 63127.

**QEDA the Queensland Electronic Distributors Association** is staging its annual Electronics display over March 23-4. QEDA currently comprises approximately 40 companies involved in the Queensland electronics industry. For further details contact Bob Hunt (07) 954-1911 or Bob Heelan (07) 277-4311.

**The Tenth Australian Personal Computer Show** is going to be held at Darling Harbour over March 20-23. All aspects of microtechnology will be included. Contact Australian Exhibition Services, 424 St Kilda Road, Melbourne, Vic 3004. (03) 267 4500.

### APRIL

**Melbourne Bicentennial Electrical Engineering Congress:** "Electro Technology: A springboard for the future", will be held over April 11-15. The Conference Manager, Bicentennial Electrical Engineering Congress, The Institution of Engineers, Australia, 11 National Circuit, Barton 2600. Phone (062) 73-2633.

**ATUG 88 — Australian Telecommunications Users Group Conference and Exhibition** will be held in Melbourne April 19-21. For conference details contact Wally Rothwell, ATUG executive director, PO Box 357, Milson's Point 2061. Telephone (02) 957-1333.

**Tekniikka 88 An International Specialised Exhibition of Automation in Industry** will be held in Finland at the Jyväskylä Exhibition centre over April 19-22. Contact the Jyväskylä Fair chairman Mr Olli Patja, Exhibition Manager, PB 127, 40101 Jyväskylä, tel (9)41-611 288 Finland.

**The 18th meeting of the Intelsat Signatories** will take place on Hamilton Island

this month. The meeting will be hosted by OTC and more than 120 delegates from around the world are expected to attend. For further information call W. Grundy (02) 230-1544.

**Commercial Opportunities From Space Transport and Related Industries Conference** will be held in Brisbane over April 26-28. The conference will examine the commercial possibilities of the Cape York

Spaceport. Contact the Secretariat, Uniquest Limited, University of Queensland, St Lucia, Qld 4067. Ph (07) 377-2899.

### MAY

**An International Aerospace Exhibition** is to be held at the Hanover Air Show from May 5-12. For more information contact Deutsche Messe—und Ausstellungen—AG, Abt 312 Messgeleenade, D. 3000 Hannover 82. Telex: 9 22 728.

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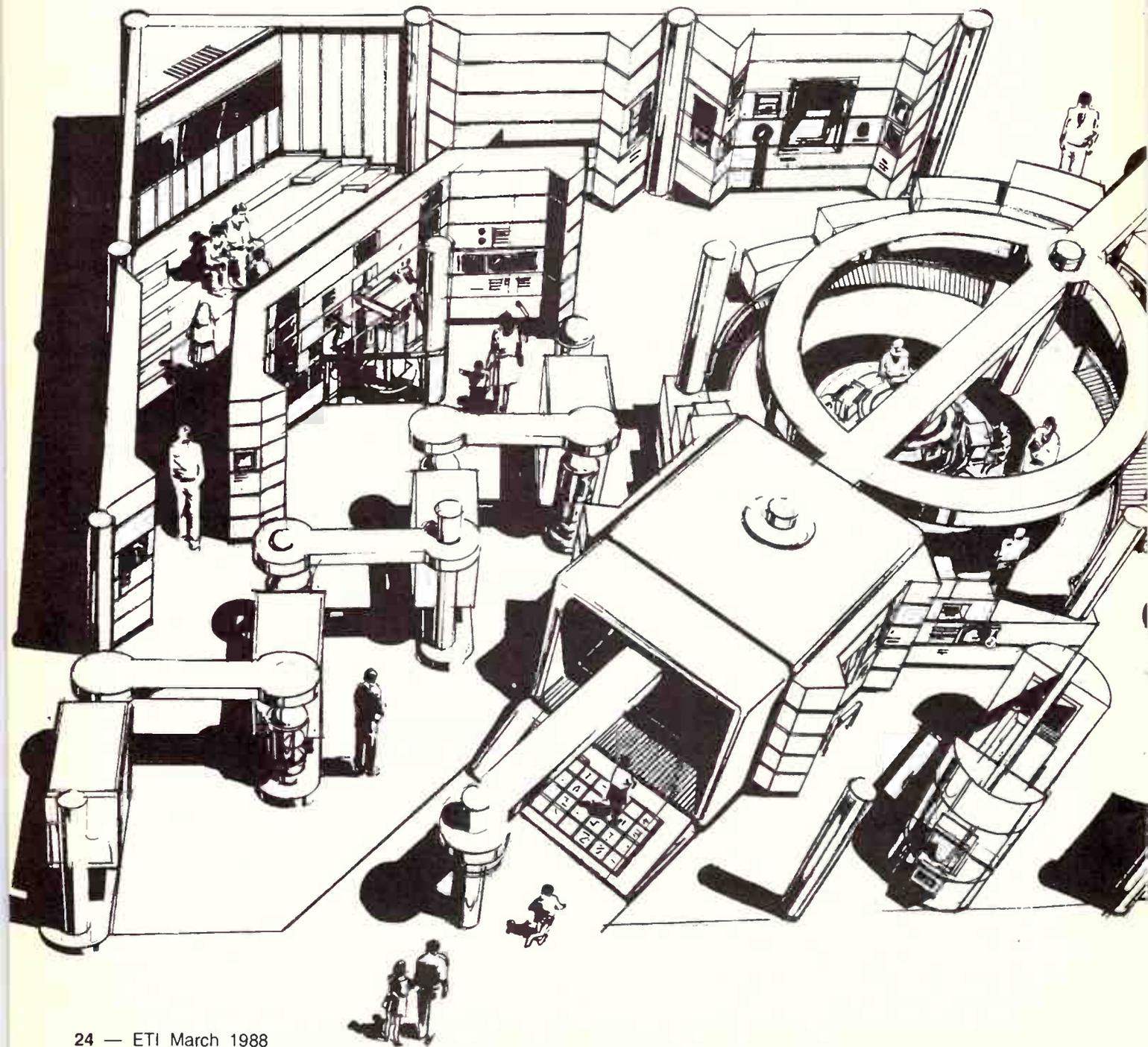
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READER INFO No. 10

# THE POWER HOUSE MUSEUM

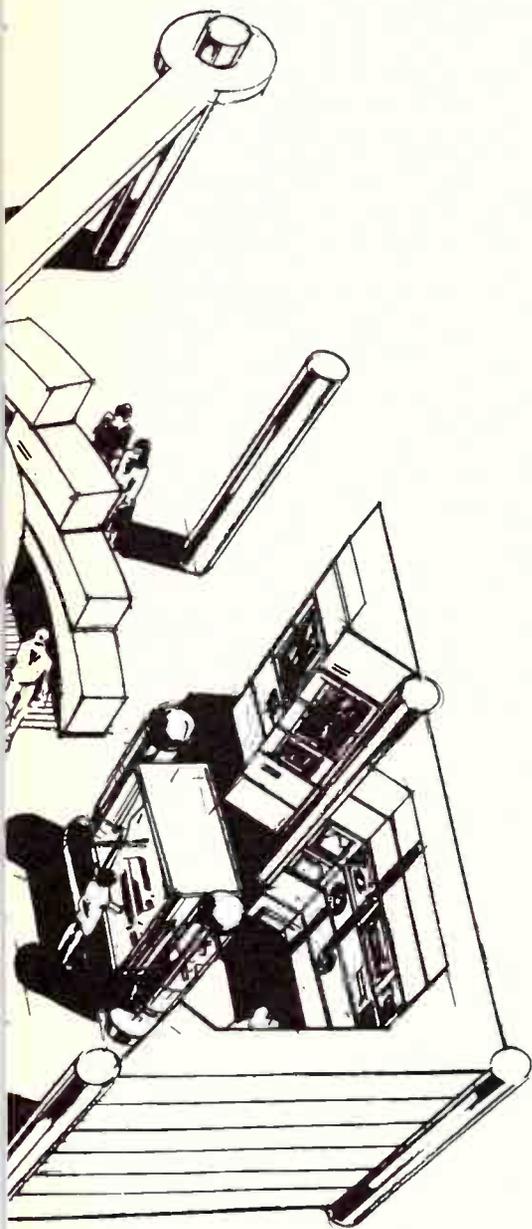


**This month, after years of planning and work, stage 2 of the Powerhouse Museum opens. We preview this exciting event and examine that section concerning science and technology, which together with the decorative arts and social history sections comprise a world class display.**

**Peter Phillips**



**The Catalina flying boat which is the largest aircraft ever to be hung in a museum.**



**S**ome readers may remember the quaint little building in the grounds of Sydney Technical College that served as the Museum of Applied Arts and Sciences up to the opening of Powerhouse Stage I. Here you could push buttons that would activate models of trains, computers and other 'marvels' of the 20th century, as well as muse over the inventions of past centuries. Then, in 1981, Powerhouse Stage I opened, built on the site of the old tram depot in Harris Street, virtually opposite the original museum. On 12th March 1988, Stage I ceases its function as a museum, to be replaced with a 2.4 ha site with buildings offering a floor space of 35,000 sq metres, allowing the exhibition of all the treasures previously held in storage along with those that were on display before.

The Powerhouse is one branch of the Museum of Applied Arts and Sciences: an organisation that dates back to 1880. Other branches are Stage I of the Powerhouse, The Mint, and Hyde Park Barracks, Sydney Observatory, and the Museum on the Move (a train). Collectively, these sites and their exhibitions compare with the Smithsonian Institute (USA) and the Science Museum of London, providing venues that match the stunning displays they house.

### **The Powerhouse Building**

The site, as most Sydneysiders know, was the old Ultimo power station, built around 1900, and originally used to power Sydney's trams. A spectacular extension has been added to the old power station, which itself has undergone considerable transformation. However, despite the changes, the flavour of the site has been retained, with overhead cranes, original light fittings and other power station miscellany complementing the displays. The total floor space is larger than the entire

Sydney Opera House, grounds and all, and provides a venue to display Australian achievements, as well as a range of fascinating items from around the world. The familiar Strasburg clock replica is back on show, as are many of the working models from the old museum. But, prepare yourself for much more; this is a spectacular place to visit, regardless of your interests.

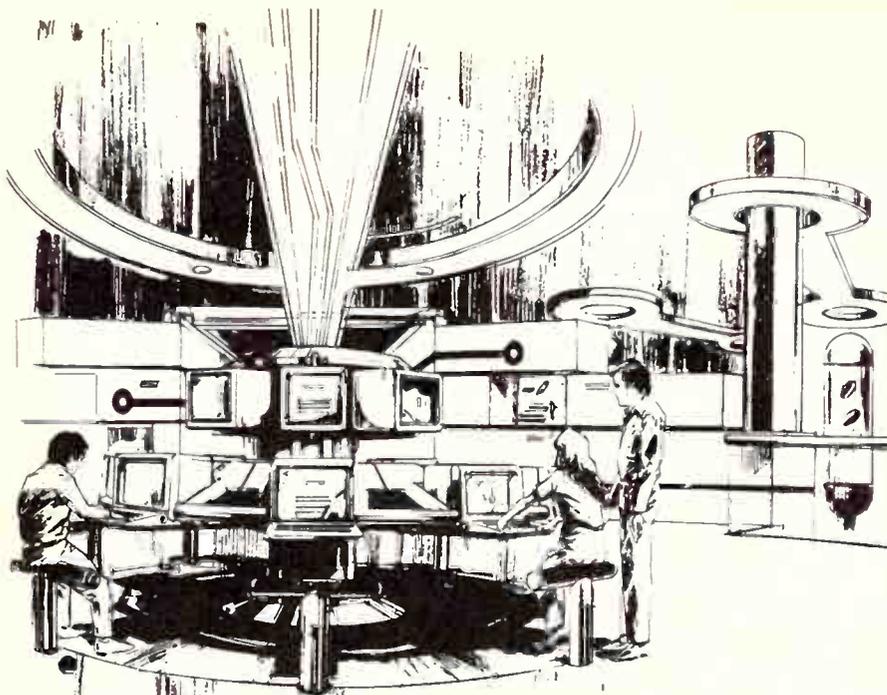
The keywords for the museum are BIG!! but accessible. For those interested in figures, the circulation route is 10km, the exhibition area is 16,000 square metres, the heaviest object is the 39 ton 12 class locomotive, the tallest is the 10 metre high Boulton and Watt steam engine (circa 1785), the largest is the Catalina flying boat with a wing span of 32 metres, and the all up cost is over \$84 million. 'Little' is represented by a 1cm high glass dog, and some items date back to 1000BC. The most valuable is probably the Boulton and Watt engine, valued at over \$30 million.

Although there are various entry points, the main entry is either from Harris Street or from the Darling Harbour area via a covered walkway. The main entry point is a huge area that acts as an information centre, and numerous computers, by way of touch sensitive screens, provide details on the 'where' and 'what'. Of course, human-human interface is also available. From here you are directed to the various areas, some of which we will attempt to describe.

### **Transport**

When you first enter this section, located in the Turbine House of the power station, the Catalina flying boat, flanked by other suspended aircraft immediately grabs your attention. The Catalina is cited as being the largest plane to be hung in any museum in the world, and was donated to the museum in 1961 by its original captain (Sir Gordon Taylor) who flew

## Power House Museum



*The central games console.*

it on a pioneering flight to South America in 1951. A Bleriot Monoplane which took the first airmail between Sydney and Melbourne in 1915 is dwarfed by its neighbours, which also include the first air ambulance used by the NSW Health Dept. The whole transport exhibition includes trains, trams, cars; even a hearse. The centrepiece is a display by Thiess Toyota, who have developed an exhibit explaining state-of-the-art automobile design and technology.

A display, claimed to be one of the world's largest and most complete collection of Matchbox toys comprises over 1600 models of cars, trucks and other toys, covering a 40 year span since Matchbox put out its first toy in 1947. Children (big or little) can play with some of these in a special play area, illustrating the museum's approach to visitor involvement with the exhibits.

Although not electronic: in fact far from it, the museum's display of steam engines and trains is likely to be a main attraction, particularly if you 'play trains' with models. Locomotive No. 1 (circa 1855) is probably the highlight, and sound tapes inside the carriages dramatise the exhibition by simulating the lives of passengers on a day's outing to Parramatta in 1863. There are three carriages, first, second and third class, attached to Loco 1, and visitors can board the third class carriage. A setting of a late 19th century railway station is used as the backdrop for another locomotive, No. 1243, with an official railway carriage (c 1890) of the Governor of NSW. A steam tram, a horse drawn omni-

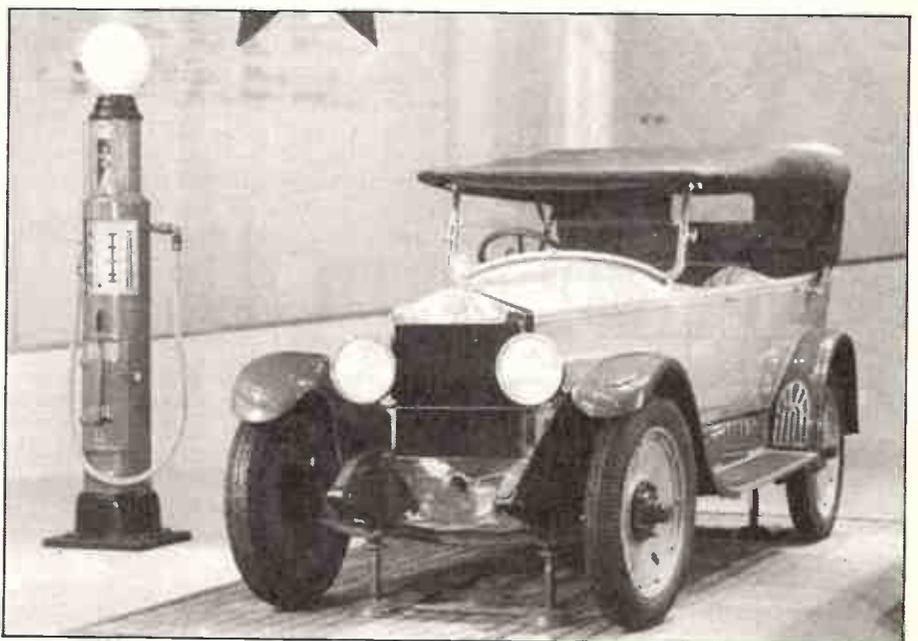
bus and other exhibits make up a display few will be able to resist.

### **The Boulton And Watt Steam Engine**

By far the most impressive exhibit is the massive 24 hp, Boulton and Watt steam engine, (c 1785) with its 6 meter diameter flywheel. This engine is now finally restored to working condition, despite having been in the possession of the museum

for over 100 years. It was originally donated to the museum following the astute enquiries of an entrepreneurial trustee of the museum (Mr Archibald Liveridge) who was in London when its original owners (Whitbread's Brewery) decided to update after having used the engine for 102 years. The only cost to the museum was the transport of the engine to Australia, which required the huge flywheel to be cut in two so it could fit on the ship. The engine arrived in Sydney during the Centenary celebrations in 1888, and now, 100 years later, Australia owns the world's oldest surviving rotary steam engine, which, according to the Minister for Environment & Planning, Mr Bob Carr, who attended its inaugural 'steaming' in November 1987, "could, if sold, pay off Australia's debt!"

According to Mr Jesse Shore, group leader of the Science, Technology and People exhibitions, this engine represents the beginning of the technological age and of our way of thinking. He cites four inventions incorporated within this machine, all patented by James Watt, who had to get around existing patents. For example, the use of a crank to convert horizontal motion to rotational was under patent, and Watt developed the 'sun and planet' gear arrangement used in this machine to drive the flywheel. The use of a governor probably represents the genesis of feedback in a machine, previously only used in a limited way to control the speed of windmills. Another problem overcome by Watt is the clever use of mechanical linkages to produce parallel motion of the piston against the arc traced by the beam connecting to the flywheel gearing. Per-



*An early hand-operated petrol pump.*



*Installing the locomotive.*

haps the most significant development was the use of a condenser. Like all engines of the day, vacuum is used to provide the motive force, developed by condensing the steam in the cylinder when the piston is at the limit of its up-stroke. Previous engines simply cooled the cylinder immediately after injection of the steam; this one uses an external condenser, which apart from increasing the available power by 7 times, also provided a closed recirculating system for the steam.

Set up in the power station's engine room, this example of 18th century technology is awesome, and should be a marvel to watch when steam is applied. It is planned to operate the engine daily, and visitors can now view the engine from various platforms arranged around it on appropriate levels, as well as operate numerous interactive displays that explain the engine's operation. A far cry from its previous home in a tin shed behind the old museum.

### **Interactive Displays**

The museum not only exhibits items of historical interest, but provides a learning environment. It achieves this with an extensive use of 'interactive displays' in which the 'Look but don't Touch' signs are replaced with an invitation to the visitor to experiment with various models that explain a technology. Amiga and IBM

computers are used to produce graphics to provide feedback that shows 'what happens when ...' in displays ranging from simple mechanical models to 'design it yourself' applications.

The Powerhouse makes large-scale use of video discs, coupled to IBM PS/2 model 30 computers. Much of the software is being developed locally, and many of the displays use touch-sensitive screens rather than the traditional keyboard for user input. There are some 31 IBMs in use, which are somewhat extended when operated in graphics, but lack the sophistication of the IBMs when it comes to other functions. Computer buffs will certainly find the interactive view. Those hardened towards gee-whiz software will probably find the interactives clever from the educational aspect. Either way, its good stuff. The interactive displays extend to all categories, including decorative arts and social sciences; a feature that is unique to the museum.

### **Computers**

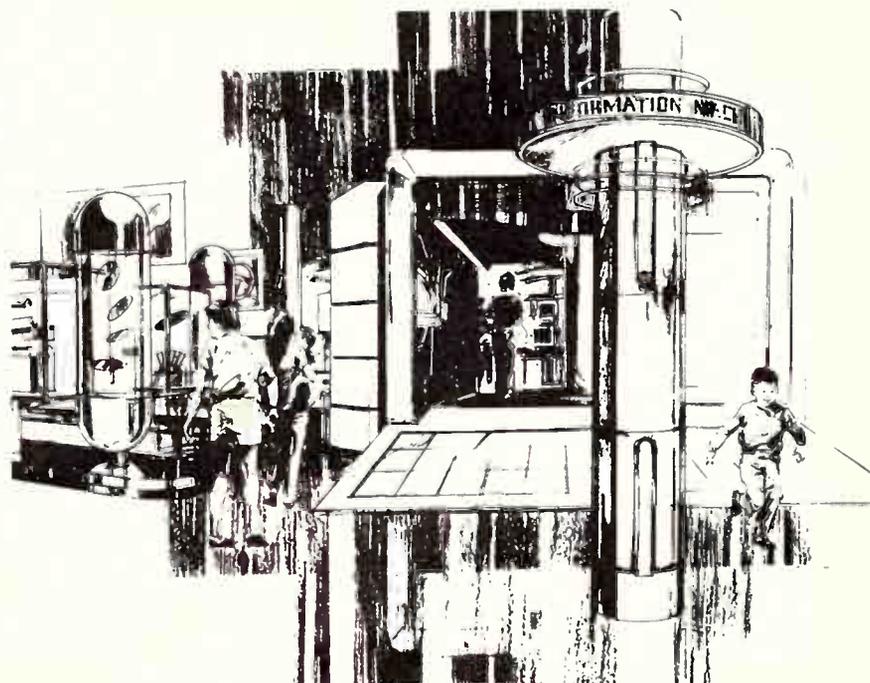
Entry to the computer exhibition is by way of the Information Machine, sponsored by IBM. You enter through an over-sized computer terminal, which has overhead neon light-tracks pointing the way to the central console. Here you feel as though you are actually inside a working unit, promoted by an elaborate light display of neons and snake lights that simulate electrical pulses covering a large 3-dimensional sculpture representing the innards of a computer. Once through the

'tunnel', the visitor is confronted with the central core, which is actually an information console. Here, young and old can learn about computers at any one of 8 personal computers which have repeater monitors around the central column enabling others to view the computer's response to a user's question. As well, the History Wall has exhibits that trace the history of calculating and computing from around 2000BC. Audio as well as graphics enhance the exhibition, which include an abacus, an 'Arithometer', an IBM 604 Valve calculator, and the first IBM PC produced in Australia.

A demonstration area seating 30 people has two specially made multi-screen videos about computers, as well as a 'Computer TV Studio' where visitors can use computer technology to create video clips with music or make short video movies. Technology is explained by the use of educational interactives in the fields of storage, micro-chip circuitry, robotics and artificial intelligence. For example, how a disc-drive works is demonstrated with a graphics display showing data in/out paths in response to user commands. You can even play a 3 dimensional version of noughts and crosses against a robot.

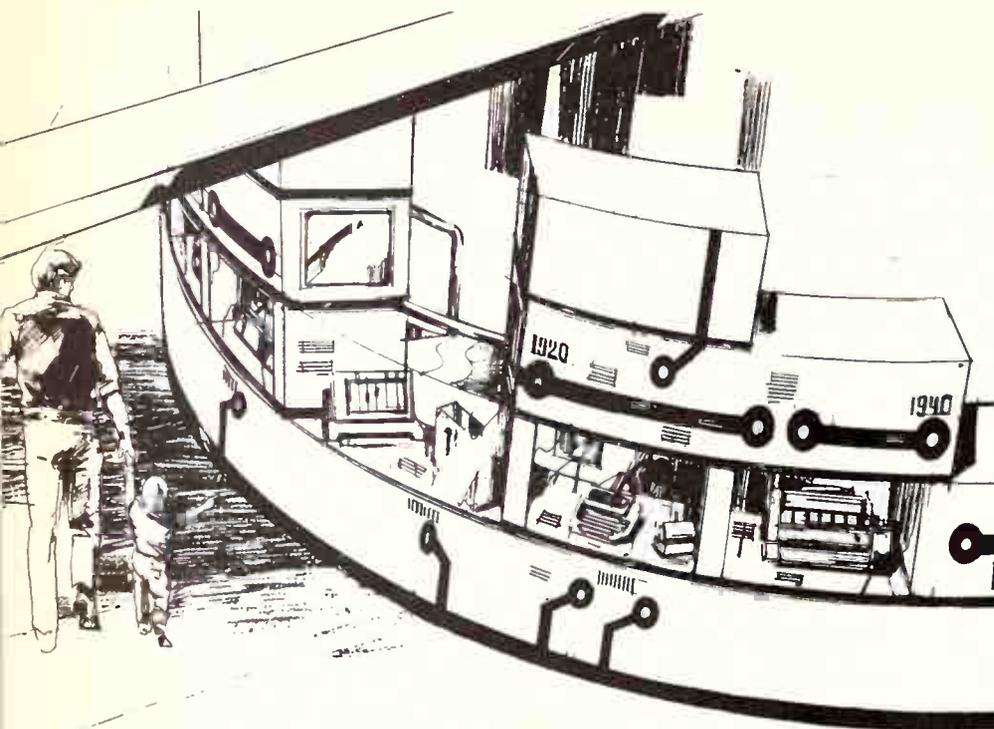
### **Space Exhibition**

Some remarkable exhibits represent space technology, including a full sized replica of the Aussat Satellite. This exhibit stands over 6 metres high, and was donated by the Hughes Aircraft Company. The McDonnell Douglas Corporation has do-

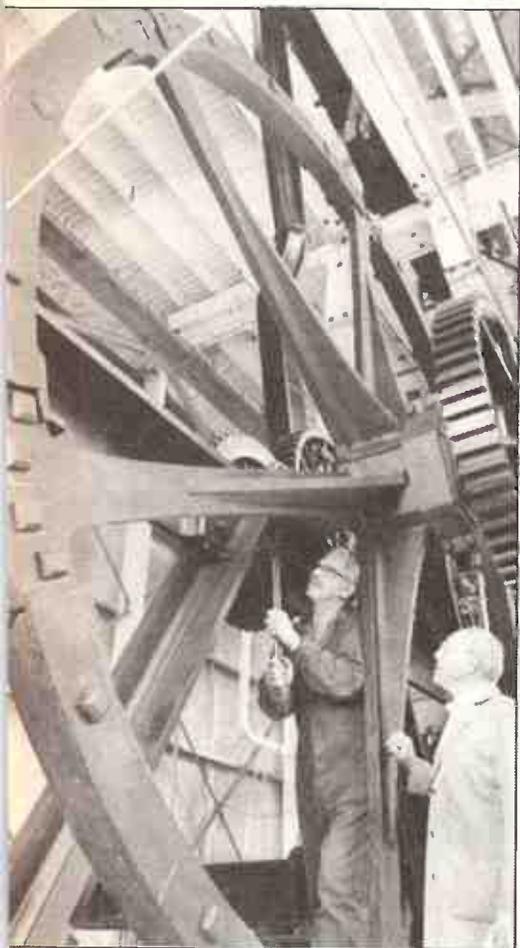


*The main entrance of the computer exhibition.*

## Power House Museum



The history wall.



The flywheel of the Boulton and Watt steam engine.

nated a payload unit module which is used to launch satellites from a shuttle cargo bay. The vice-president of this company is Charles Conrad, the third astronaut to walk on the moon. Other exhibits are due for display when an international 'space exhibition' opens in October 1988, including some space hardware on loan (for 7 years) from the Academy of Sciences in Moscow as well as a variety of items from the USA and China.

This exhibition will show such items as a model of Sputnik 1, launched October 4th, 1957, and replicas of a Soyuz re-entry capsule, and a Soyuz 4-5 spacecraft. The Soyuz range of spacecraft is largely unchanged over its 20 year history, and have been used to ferry Russian cosmonauts to and from the world's first experimental space station. There will be a total of 14 space related objects from the USSR, which range from busts of notable Soviet space pioneers to replicas of a Luna 9 moon lander, Lunakhod moon rover, Cosmos satellite, various deep-space probes; even examples of space food.

### Technology

The Powerhouse museum features technology in a way few museums would dare. Forget stuffed marsupials in glass cages, here you will find displays that 'fizz and bang', or that demonstrate thermal imaging, polarised light etc. The 'plazma' ball, described as a miniature lightning display, is a fascinating example of what is now becoming an up-market decorative item. A plazma ball is simply a glass sphere, ex-

hausted of all gases with the exception of a small amount of inert gas, fitted with an electrode placed centrally within the sphere. A high voltage is applied to the electrode, sufficient to cause ionisation of the surrounding gas in an unpredictable way. Holding your hand on the sphere will direct the ionisation to that point on the sphere, with little or no sensation. More recent models allow them to be connected to a sound system, giving discharges in time to the music.

Another high voltage device is a Wimshurst machine built by the staff of the museum. These devices are beloved of twisted Science teachers, with their invitations of 'hold the terminals, son,' although the museum's model is much larger, with an output of up to 100kV. Another more macabre display is the 'Interactive Electric Chair.' Here, with (we hope) no pain to the user, you can explore human conductivity, and discover how this phenomenon was used to fry unfortunate victims sentenced to 'The Chair'.

Other technology interactives include 'TV with a twist', in which the user sits before a video camera, and experiments with a magnet against a TV screen. The deflection of the electron beam caused by the magnet produces a corresponding distortion to the picture, demonstrating deflection of an electron beam by an external magnetic field.

Medical technology is demonstrated with interactive displays on implant techniques, electronic Bio-feedback, etc., as well as exhibitions on the development of medicines and drugs.

### Communication

As you would expect, sound and video is well represented. A 1930's style Art Deco movie theatre, complete with a 'Fotoplayer', offers visitors various early Australian films and newsreels. The Fotoplayer is a pedal operated player piano, with all kinds of pneumatically operated sound effects, restored by Mastertouch at Petersham. Other mechanical musical instruments include an Ampico reproducing piano, as well as a Dynacord push-up player. There's even a 17th century virginal.

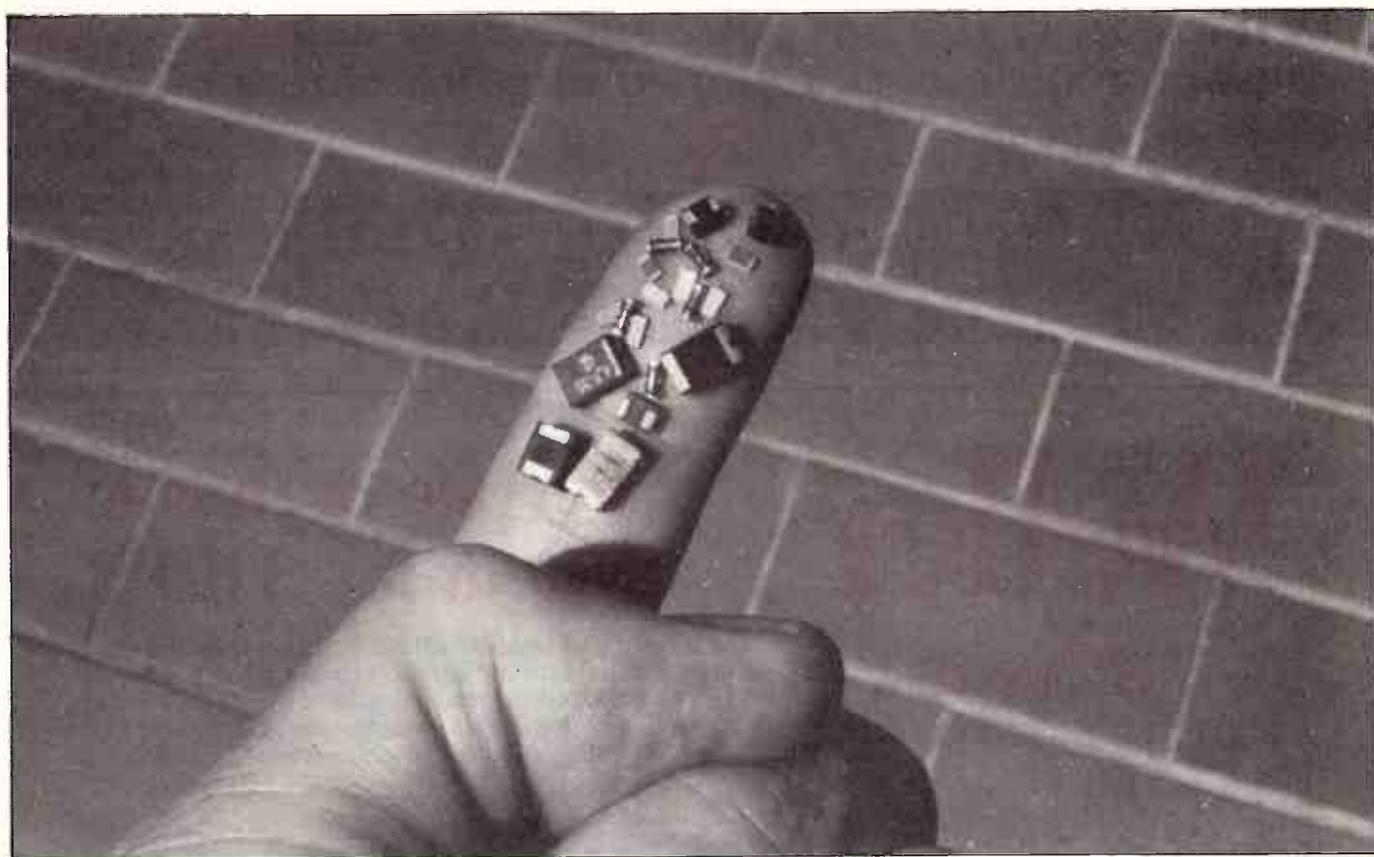
In fact, the whole museum is an example of communications. The many interactive displays, the touch-screen computers and the various demonstrations provide an environment that aims to remove the intimidating feel of much of the technology in current use. Grandma will love it, as will the kids an' all. And this is a resume of the technical aspects only; don't forget its also an ARTs museum. ●

*Our thanks to museum staff members, Miss Jane Gillman and Mr Jesse Shore in the preparation of this article.*

# SURFACE MOUNT TECHNOLOGY

*The first of a two part look at the state of Surface Mount Technology in Australia.*

Les Cardilini



**S**urface Mount Devices (SMDs) are likely to have replaced at least 50 percent of conventional, leaded components (components which have leads) on new printed circuit board assemblies by 1990, according to the giant electronics company Siemens.

SMDs can already be found in a wide variety of imported products — from VCRs, video cameras and telecommunications equipment, to computers and control systems. Consumer product service manuals tend to offer at least a page or so of advice to technicians who may for the first

time have to service or re-work printed circuit boards and substrates utilising surface mount technology. That the supplier deems it necessary to offer that advice is also a timely warning to those likely to come into contact with SMT at the re-working and servicing levels.

Some updating of hand skills and knowledge of SMT may be necessary, if the supposed improved reliability of products using SMT is to be maintained. For example, a probe placed too firmly in the wrong place near an SMD on a flexible substrate could fracture the solder connec-

tion between the small component and the solder pad on the board. On such a small joint, simply casting an eye over the finished repair may not reveal the latent problem which might heal temporarily but nevertheless render the parent equipment unreliable until the fault is rectified.

Will 1988 be the year that Surface Mount Technology (SMT) blinks its eyes, stretches out its arms and really starts to develop more rapidly on the Australian electronics scene? Some manufacturers here are already geared to SMD techniques in production and a number of

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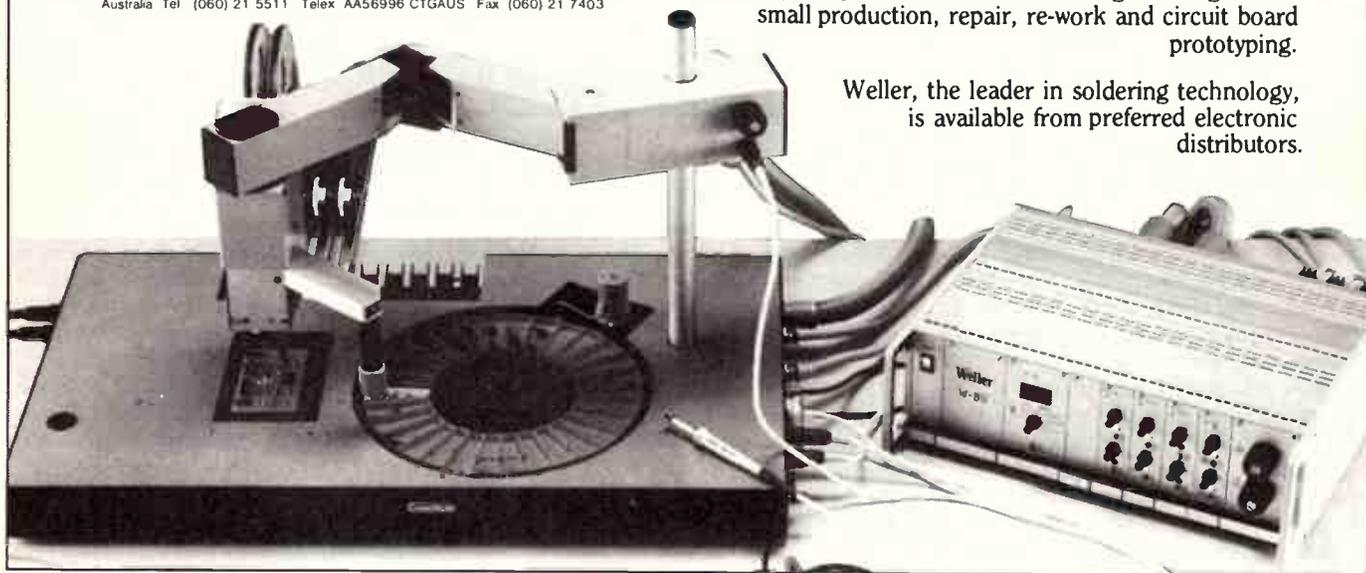
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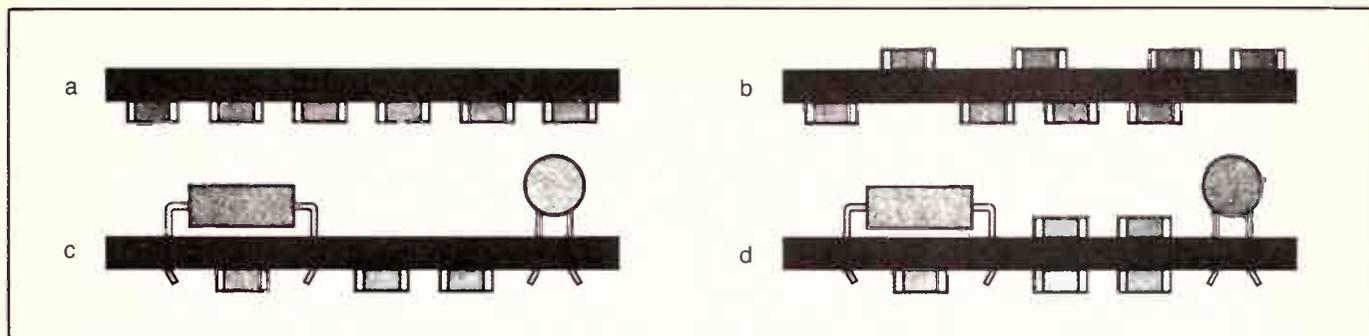
The Weller Pick-Place-Solder (PPS) is a self-contained manual work station for the application of glue or solder paste spots and the positioning, removal, soldering or de-soldering of SMD's by temperature controlled inert gas. Designed for small production, repair, re-work and circuit board prototyping.

Weller, the leader in soldering technology,  
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READER INFO No. 11

## Surface Mount Technology



The way in which SMDs can be mixed and matched with conventional components; 1) shows a single sided, and b) a double sided, SMD board. Since SMDs are highly tolerant of molten solder, it is possible to solder such an assembly during one pass through a solder bath. c) shows leaded components on one side and SMDs on the other, a configuration that requires only one pass through a solder bath and is very popular for that reason. d) shows leaded components on one side and SMDs on both sides. Courtesy Siemens.

local distributors are selling surface mount production plant and equipment. Systems are available which range from manually operated research and development packages for assembling SMT prototypes and small batch runs, to larger, high volume, software-managed production machines capable of attaching SM components at rates of up to 10 thousand or more per hour.

Automation also implies a degree of standardisation of the new shapes and sizes of components for surface mounting and how they attach to a printed circuit board or substrate. The IEC, EIA and other organisations specify pinout and body profiles for a variety of passive components and integrated circuits which are intended to attach onto, rather than through, printed circuit boards.

### Traditional Outlines

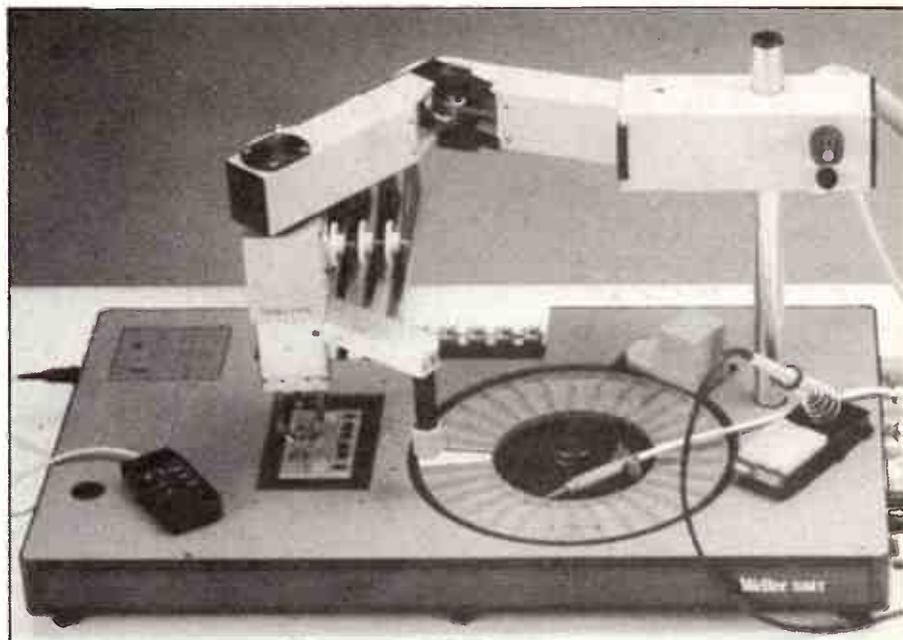
Of course, one of the main differences between traditional component outlines and equivalent Surface Mount Components (SMCs) is their size. Inherently, many SMCs are so small that it is not easy to effectively identify their functions and values simply by inspecting the components themselves.

The length and width of some SMCs can be determined from their package ID codes. The notation used in the IEC size/package code for cubic, surface mount resistors and capacitors, in fact states their flat measurements in hundredths of an inch. For example, the 0805 package is eight hundredths of an inch long and five hundredths of an inch wide, whilst the 1206 package is 0.12 inches long and 0.06 inches wide, and so on. Most specification tables, however, go on further and indicate the package dimensions in millimetres. Even an IC considered relatively large in a dual in-line package is not likely to have dimensions exceeding ten millimetres in its SMC execution. Some are slightly

larger, but nonetheless, it is not difficult to hold an assortment of twenty or more SMDs on the end of one finger.

Their miniaturisation also means that in many instances new packaging methods are needed in order to handle and dispense them efficiently. Some SMCs are available in loose or bulk form but typically they are supplied in packed and tested lots of a thousand or more, bonded or seated loosely in blisters formed on reels of tape. Other component packaging

methods include stick, stack, linear and waffle magazines each containing a specified number of SMCs. The appropriate magazines are simply loaded into a software controlled robotic machine which picks up the SMC from its respective packing and places it on the board or substrate being assembled. Alternatively, with a smaller manually-controlled assembly device loose SMCs can be handled with vacuum pens, and footswitch operated pressure systems which dispense ad-



The Weller PPS is one of a new generation of manually-controlled machines designed for working with low volumes of surface-mount products. In fact it is ideal for prototypes and repair work. The carousel at right holds all the components. At left is a vacuum lifter to pick up the components, and a heater to melt the solder. Courtesy Cooper Tools.

READER INFO No. 127

## Surface Mount Technology

hesives and solder pastes from syringe-like applicators.

### Assembly Methods

A variety of assembly methods is possible using SMT. SMDs may be used alone and on one or both sides of a printed circuit board or substrate. In production it is also possible to mix them with traditional, leaded components. Accordingly, a manufacturer need not totally discard leaded components and through-the-board production equipment. Rather, SMT can be cased in beside existing equipment and developed and extended if desired.

Perhaps the clearest departure of SMT, from through-the-board mounting is in the fixing of components to the substrate pc board. Un-leaded components, of course, do not require the board to be drilled but an alternative method is needed to support a surface mount part in place until it

is soldered.

In the case where only SMDs are to be attached to a substrate or pc board a solder paste, which eventually will form the electrical connection between the SMD terminals and the printed circuit wiring, can be used to support the component in position until soldering takes place. Usually, soldering is effected by melting the paste and evaporating its binders and other fluids, in a controlled heated environment such as a zone of hot inert gas or by exposure to infrared radiation.

Where mixed components are used, SMDs will need to be fixed in position on the traditional solder-side of the substrate, where the leaded component leads are clinched and soldered. Typically, this will involve wave soldering. Since the SMDs will be submerged in the solder waves, they must be held in place by a stronger,

adhesive placed on the substrate either manually or by automatic dispensers depending on the complexity of the equipment and size of the project. A more involved mixed process still, would be to use double-clad substrates, with SMDs soldered on one side and mixed components, soldered on the other, in a second process.

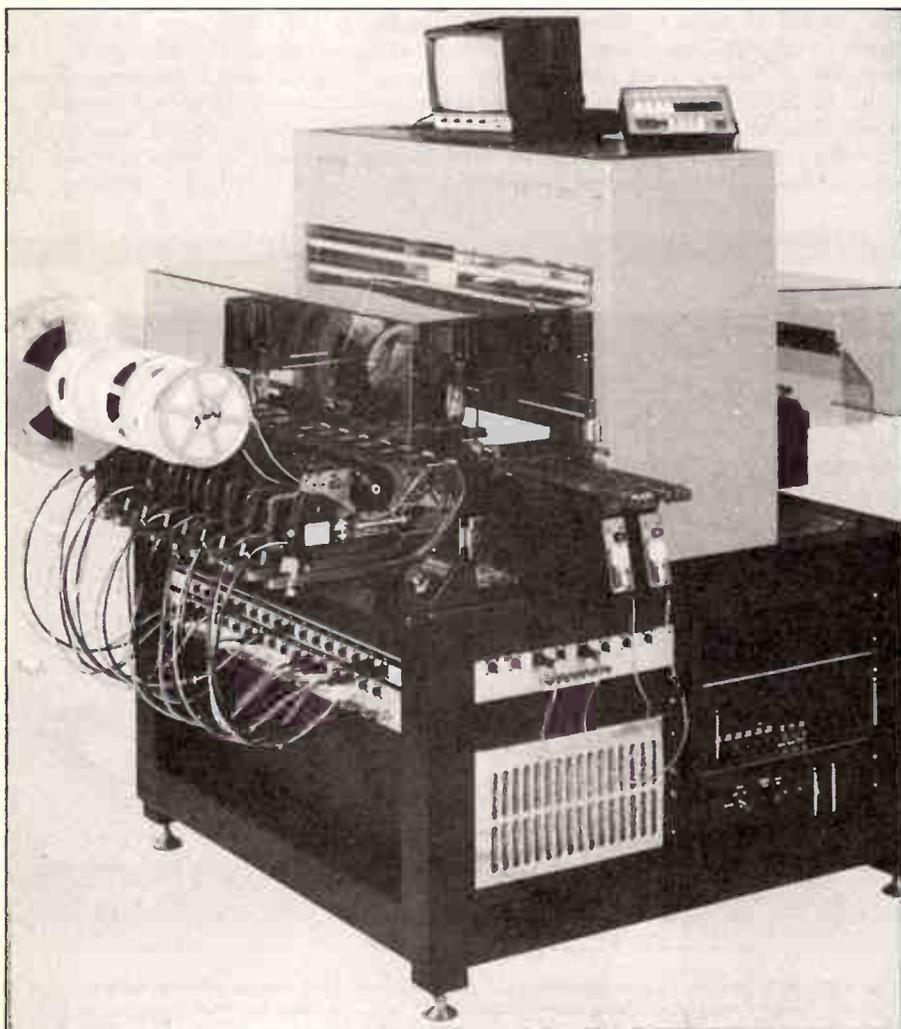
Accordingly, when removing SMDs from a substrate it may be necessary to soften or break away glue or adhesive bonding the component to the board, as well as to de-solder the connections from the board wiring. This will depend, of course, on the way the SMDs were assembled in production.

Whatever the SMD, be it a simple resistor or capacitor or a large IC or micro-processor, the lead wires within the component and those to its connecting pads are either effectively eliminated altogether or significantly reduced in length when compared to traditional components. This also brings about a significant reduction in lead inductance and tends to enhance the speed capabilities of such devices in digital circuits and higher radio frequency applications. The absence of leads also reduces the susceptibility of components to vibration fatigue.

### Geometry

The geometry of Surface Mount Devices is a crucial factor in assembly. The accuracy of pc board layout, pad size, component placement and centering in relation to mounting facilities on the substrate leave little room for error. Perhaps this feature of SMT is highlighted by the fact that a rectangular or cylindrical SMC held in place by solder paste on pads of different size is likely to twist and stand on one end if the surface tension in the solder is different at each end of the component when the solder is melted. This fault in board assembly is called "tombstoning" or "drawbridging" for obvious reasons. A similar fate might await an SMD which is positioned closer to its mounting pad at one end than the other or twisted out of tolerance in its X-Y orientation on the substrate. Unequal pad areas might also cause tombstoning of small SMCs.

The relative ease with which tombstoning might occur during the melting of solder paste on the production line is more readily appreciated when the size of a typical SMD is taken into account. For example, a ceramic capacitor SMD might be only two millimetres long, 1.25 millimetres wide and just over one millimetre high, weighing in at about 15 milligrams! **Next month a follow-up article will look in depth at boards and manufacturing technique used in surface mounting.**



A typical 'entry level', (ie: cheap) surface-mounting machine is this Omniplace 4618 from Universal. It can place components to an accuracy better than 0.025 mm. The components enter the machine mounted on the bandoliers at left. The boards enter at right. The machine is fully programmable and comes with a controller with 256K of memory on board. Courtesy Universal.

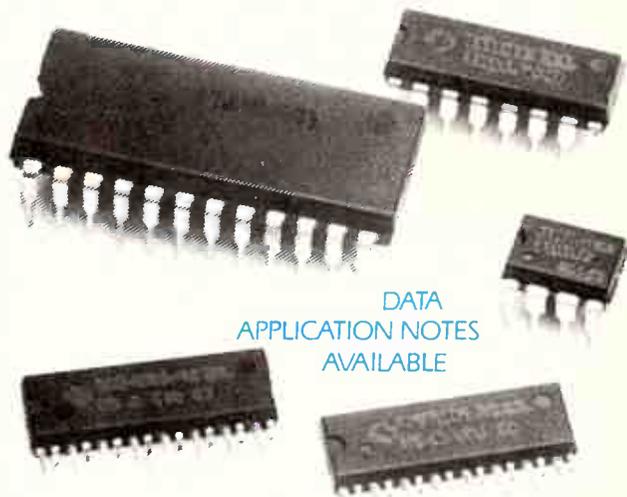
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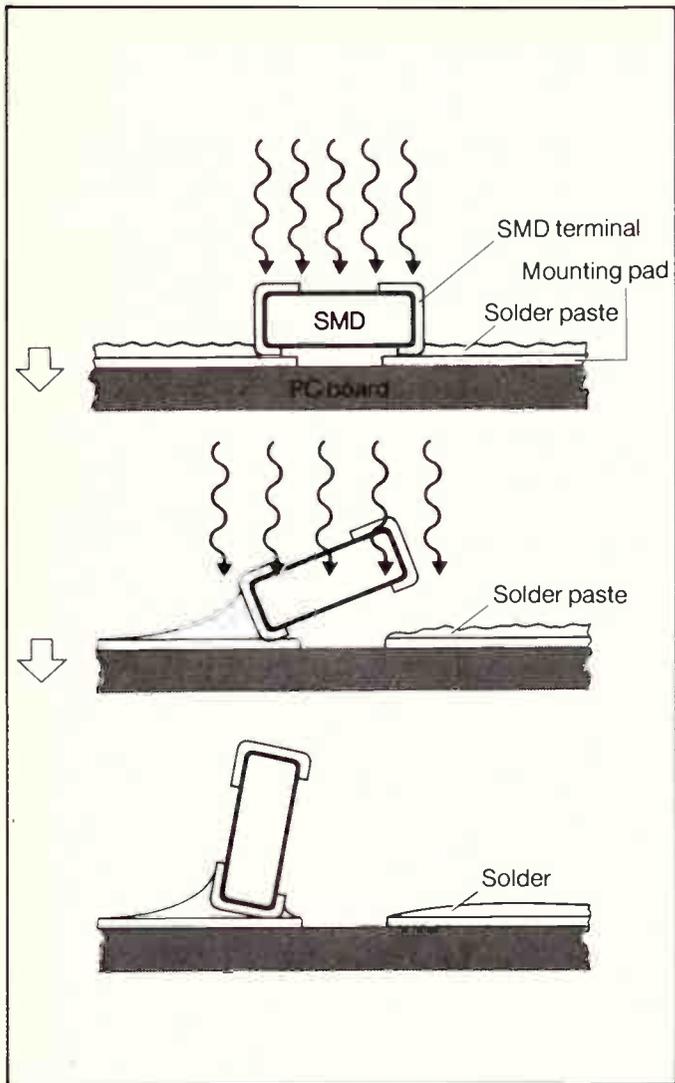
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COLBAR



*Tombstoning is one of the major problems facing surface mount manufacturing. If the solder does not melt on both pads simultaneously then the surface tension of the solder mass that first melts will pull the SMC upright. This can be caused by insufficient metalisation of the component itself, uneven wetting of the terminals, asymmetrical pads or different amounts of solder on the pads. Courtesy Siemens.*



*A typical modern reflow soldering system from Vitronics. It is intended as an integral part of the manufacturing line of the future — the boards go in one end, the operator does a bit of programming in the middle, and the finished boards come out the other. The messy, smelly, dirty process of wave soldering can at last be consigned to the bin. Courtesy Penn Central.*

READER INFO No. 129

# HIDDEN DANGERS

*Do the X-rays generated by TV sets and VDU units pose a hazard for users? This article looks at how X-rays are generated and the mechanism by which they may damage health.*

John Bell

**R**ADIOACTIVITY is caused by the disintegration of atomic nuclei and manifests itself in the emission of various particles and gamma rays. On earth there is always a natural background radiation which is caused by the spontaneous disintegration of heavier elements or by events which take place in the cosmos. Man-made X-rays are produced by inducing this disintegration of atomic nuclei by bombarding a suitable target with high-speed electrons. The penetration of an atom by a high-speed electron may result in the removal of an electron from the inner electron shell, which gives rise to the emission of a number of frequency spectra as other electrons rearrange themselves in orbit around the atomic nucleus. If the voltage used to accelerate the electrons is measured in hundreds of kilovolts, hard X-rays of great penetrating power are produced: where tens of kilovolts are used, as in some X-ray tubes and in cathode ray tubes, soft X-rays of little penetrating power are generated.

The human body contains vast numbers of living cells which must be capable of reproducing themselves to deal with the demands of growth, tissue repair, etc. etc. To achieve this, cells must divide repeatedly, each time replicating themselves precisely. In order to enable this reproduction of identical daughter cells to proceed, information is encoded onto lengths of deoxyribonucleic acid (DNA) called chromosomes. Thus, when cells divide the chromosomes must be replicated precisely so that identical generations of specific cells will follow. If this replication is not exact a mutation results: although most mutations are recessive and are extinguished, there remains the possibility that the mutant cells may survive to multiply, giving rise to possible health or other problems.

Mutations may be caused by a number of factors including radiation; furthermore, as mutations may be genetic in character, they can be carried forward for several generations before expressing themselves. There is always an amount of background radiation due to naturally occurring events and it is against this natural level that the human race has developed:

indeed some authorities argue that some parts of the evolutionary process have occurred because of the selection of beneficial mutations due to this cause.

## X-rays from Tubes

Consider the colour television tube which typically has a final anode voltage of some 25 kilovolts (kV). Clearly, there will be a considerable electric field between the anode and cathode(s) so that electrons emitted by the cathode(s) will be accelerated to a high speed before suddenly being brought to a stop as they hit the shadow-mask or screen phosphors and supporting structure. Here, in fact, is the basic mechanism for producing soft X-rays. However, because the materials comprising the screen and its adjoining components are not chosen to facilitate X-ray emission the level of X-radiation is low compared with an X-ray tube. The detailed specification for a cathode ray tube or visual display unit will often indicate the level of X-radiation which may be expected. The specification may say that the level will be less than 0.5 milli-roentgens (mR) per hour (which is the accepted maximum figure) and may also indicate what the manufacturer anticipates under normal working conditions — such a level may be quoted as 0.1 mR/hr. The unit roentgen is used here to define the amount of ionization caused by a given source.

## X-rays and the Human Body

When studying the effects of ionizing radiation in human tissues we are dealing with the absorption of energy and so the term rad is used. However, the human body is a complex mixture of tissues receiving ionization by adopting the concept of a roentgen equivalent man (rem). In the case of soft tissue, characterised by the eyes or gonads, the roentgen, rad and rem may be taken as being equivalent. Most data sheets will use these units. From these relationships we conclude that:

$$\text{Absorbed radiation dose (rems)} = \text{roentgens} \times \text{exposure time} \dots\dots\dots (1)$$

The background radiation level out of doors at sea level is approximately 0.011

mR/hr, that is 0.096 rems per year. This background level varies with geographical location, altitude and other factors and so this figure will be rounded off to 0.1 rems per year. Against this background and statistical data, the National Council for Radiation Protection (NCRP) has suggested maximum dose limits from all other sources of radiation per calendar year. These limits are in addition to the natural background radiation level. A small part of these recommended limits are shown in Table 1.

Dose Limit (rems)	Description
0.17	General population
0.5	Fertile women in gestation period
0.1	Students
5.0	Maximum dose for occupational exposure

Table 1. — NCRP Suggested Dose Limits per Calendar Year

## Radiation Level Calculations

Now, let us consider a simple television set or monitor. We will also assume that the only radiation will be from the tube face, that is the system has been adequately screened. A typical well written specification will generally indicate that the radiation level, measured at five centimeters from the tube face, will be within the Australian standard of 0.5 mR/hr. If one now examines the corresponding data sheet covering the cathode ray tube it should be possible to deduce the X-radiation level corresponding to various anode voltages using an appropriate limit curve. Figure 1. shows typical X-limit curves which represent expected X-radiation levels from tubes operated with a nominal final anode voltage of 12 kV and 25 kV respectively. At the standard recommended anode voltage the X-radiation level could be, say, 0.001 mR/hr, on the other hand the top end of the limit curve of the same tube could be as high as 5 mR/hr.

The information presented in Figure 1. assumes that the anode currents, remain

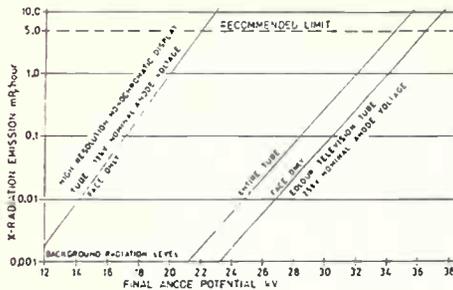


Figure 1. — Typical X-Limit Curves for Representative Cathode Ray Tubes

constant as anode voltages are raised. In practice this is not so and the designer of equipment will need to refer to iso-exposure graphs (Figure 2.) to ensure that recommended limits of X-radiation are not exceeded for various combinations of anode voltage and current. Moreover, from a purely practical point, the user of a television set or VDU will frequently adjust the brightness of the picture or display and this is, of course, achieved by controlling the anode current. Hence, in reading levels from Figure 1. we must always bear in mind that the values will be increased as screen brightness is increased.

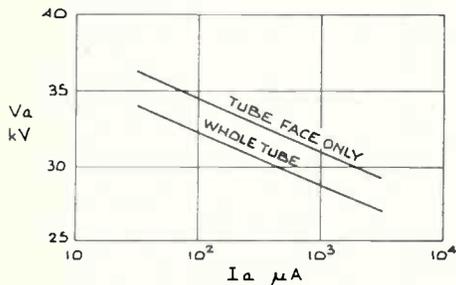


Figure 2. — Iso-Exposure Graphs for a Typical Cathode Ray Tube

The graphs presented in Figure 1. illustrate a few important points. It will be seen that over the linear region of operation of the tubes that we have straight line graphs when the vertical scale giving levels of radiation is plotted logarithmically for a constant value of anode current. Furthermore, it will be seen that the basic radiation level is higher for the tube operating with the higher anode voltage and that the emission from a whole tube (see the 25 kV case) is much greater than from the tube face alone. In our calculations we will restrict ourselves to the 12 kV tube case which is typical of monochromatic tubes.

There is some difficulty in establishing what level of X-radiation should be used in determining whether there is a potential hazard or not. One could use the "worst case" of 0.5 mR/hr, use a gross fault condition or the idealised situation of cor-

rect operation and no-fault conditions which could yield a figure of 0.02 mR/hr for instance. Let us look at this problem in a little more detail by examining the relationship which may be used to calculate emission from a tube face, that is:

$$\text{Emission} \propto V^n I Z \dots\dots\dots (2)$$

where V is the anode to cathode potential, I anode current and Z is the atomic number of the target material. The index 'n' is dependent upon the geometry of the tube and operating conditions; it may be deduced from X-limit curves using logarithms and would normally be in the range of about 12 to 20. Equation (2) enables us to calculate the X-radiation levels in given situations without recourse to consulting the limit curves each time. In our X-limit curve 'n' will be found to be 15.

From equation (2) it is seen that the X-radiation level is proportional to both the final anode voltage raised to the power 'n' and anode current.

Considering voltage to start with, this implies that tubes, with higher final anode voltages, typically 25 kV, are the one most likely to emit higher levels of radiation. Furthermore, if we keep I constant, it is easy to use Equation (2) to calculate the increase in radiation by increasing the anode voltage. Denoting two sets of conditions by subscripts and dividing we obtain:

$$\frac{E1}{E2} = \frac{V1^n}{V2^n} \dots\dots\dots (3)$$

(Note that as I and Z are constant they have been cancelled out.)

If we use 15 as the value of n, taken from the X-limit curves of our low voltage monochromatic display and increase the voltage by, say 20 per cent, that is 12 to 14.4 kV we write:

$$\text{Increase in emission} = \frac{14.4^{15}}{12.0^{15}} = 15.4$$

That is, the emission has increased over 15 times for a 20 per cent increase in voltage and the tube which would normally be emitting 0.008 mR/hr would have its emission raised to 0.012 mR/hr. (In the case of the TV tube, 'n' is 17.2 and there would be a 23 fold increase in radiation for a 20 per cent increase in anode voltage.)

This calculation has highlighted a potentially dangerous situation with colour television or monitor tubes. Simply stated, if correctly operated and maintained, there is unlikely to be a hazardous radiation problem, but if fault conditions give rise to excess anode-cathode potential or radiation screens are removed, the level of X-radiation can increase dramatically.

There are two factors which assist in reducing the level of radiation absorbed by human tissue. Equation (2) indicates that X-radiation is dependent upon the value of anode current I. No current, no picture no emission! The smaller the illuminated area of the total screen, the smaller will be the total emission; thus the VDU operator who uses a small portion of the available screen for presentation of data is subject to less radiation than if faced with a standard television-type picture. The second factor is based on the inverse square law of physics which states that the energy received from a point source is reduced by a factor of four each time the distance between a point source and the receiver is doubled. In the case of the CRT, the emission level is measured five centimetres from the screen face, so if we view the screen from a distance of 3.2 metres the distance has been doubled six times. Hence, if we assume the tube face to be a point source (which is not unreasonable at this distance) the received emission level from a normal television viewing distance is reduced by a factor of 4096!

### Practical Implications

Having explained some of the basic principles involved we are now in a position to return to Equation (1) and consider what could happen in practice with a television set. If one takes the absolutely worst case of 0.5 mR/hr for legal operating conditions, the time taken for a student to accumulate 0.1 rems reviewing the screen from a 5 cm range, which very small children and users of light pens may do, will be  $0.1/0.5 \times 10^{-3} = 200$  hours. If one now takes a radiation level of 0.01 mR/hr the time taken to accumulate 0.1 rems is  $0.1/0.01 \times 10^{-3} = 10000$  hours. Finally, even taking a radiation level of 0.5 mR/hr it is clear that to accumulate a dose of 0.1 rems at a distance of 3.2 metres would take  $200 \times 4096$  hours or 93 years!

### The VDU Case

Because of the closeness of a VDU operator to the screen, the operator will accumulate a higher radiation dosage over the same number of hours. Let us assume that the average VDU operator sits 40 cm away from the screen and estimate the emission received. Unfortunately, however, we cannot use the inverse square law directly in this particular case as, at a viewing distance of 40 cm, the screen cannot be approximated to a point source. If we assume, for the moment, that the screen was a point source we would have a reduction factor of 64 for an eight-fold increase in distance. As the calculation of

## Hidden Dangers

the reduction factor under these conditions would involve quite horrendous calculations we will just assume the factor is reduced by half ie: 32. Thus, if we take the worst case of 0.5 mR/hr which yielded a figure of 200 hours for students to accumulate 0.1 rems five centimetres from the screen, it is derived. That is, the level of exposure to a VDU operator in one year is about a third of the maximum recommended limit for a student. There is however a definite risk factor associated with the use of a display at extremely close quarters which could occur if a light pen, for instance, was being used. Clearly in this case we are back to the figure of 200 hours.

### Discussion

From our brief deliberations it is self-evident that the feel of X-radiation from correctly designed, maintained and operated domestic equipment under no-fault conditions should be close to background radiation levels and, furthermore, if reasonable distances are maintained between the source and viewer the received energy levels should be miniscule. Perhaps the real hazard is that one's senses are not capable of detecting the presence of ionizing radiation at less than supra-lethal



levels despite the fact that significant biological damage may have occurred.

### Other Factors

Other factors are that radiation dosage is both additive and accumulative and that irradiation occurs from many sources. Increased low-level radiation is associated with luminous displays (10 times), high altitude flight (3 times) and, of course, with particular nuclear related activities. A set of X-ray photographs taken under medical

supervision, would almost certainly exceed the total annual radiation received from all low-level background levels combined. It should now be clear that the calculation of absorbed dose for a given year is a most difficult exercise and must necessarily contain many estimates. It is for this reason that people who are occupationally exposed (Radiographers, nuclear workers etc.) carry devices with them which allow the amount of irradiation to which they have been exposed to be measured. Typically occupationally exposed personnel are allowed to accumulate five rems in a given year, thirty times more than for a member of the general population.

### Conclusions

One may therefore conclude that the level of X-radiation received by a VDU keyboard operator would be expected to be comparable with, or below, the natural background level: it is thus self-evident that the radiation level received by the average television viewer will be well below this figure. Nevertheless, personnel who maintain prolonged close contact with cathode ray screens or tubes are in a potentially hazardous situation as they are likely to be recipients of ionizing radiation above the NCRP recommended limits.

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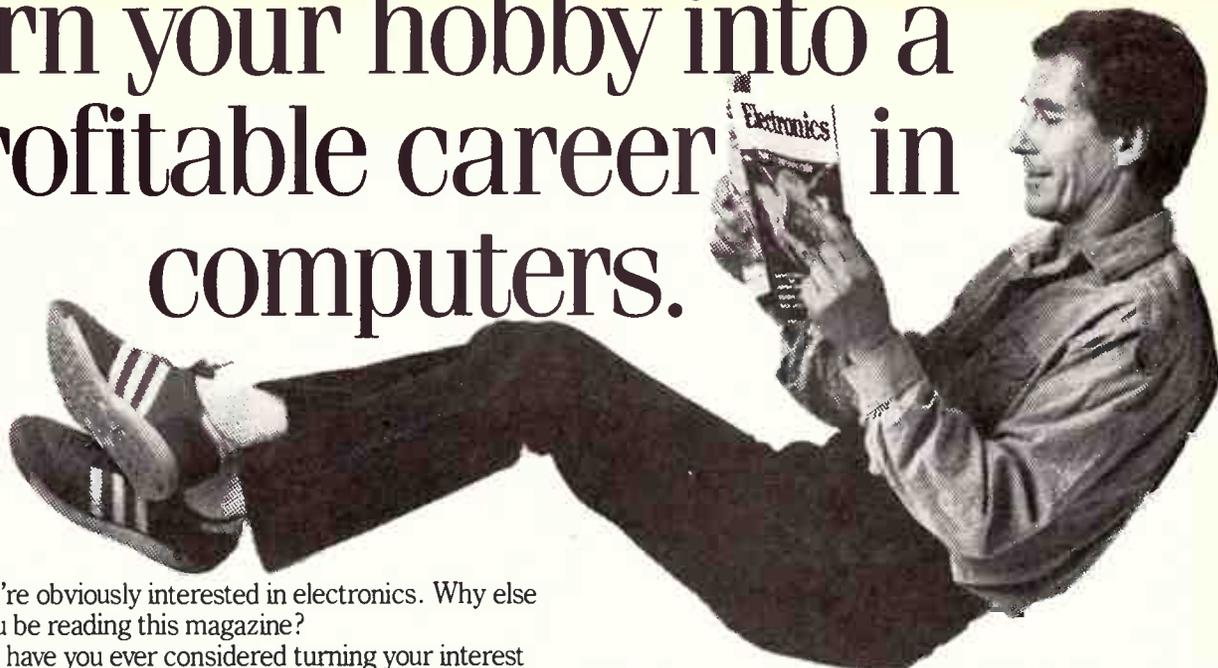
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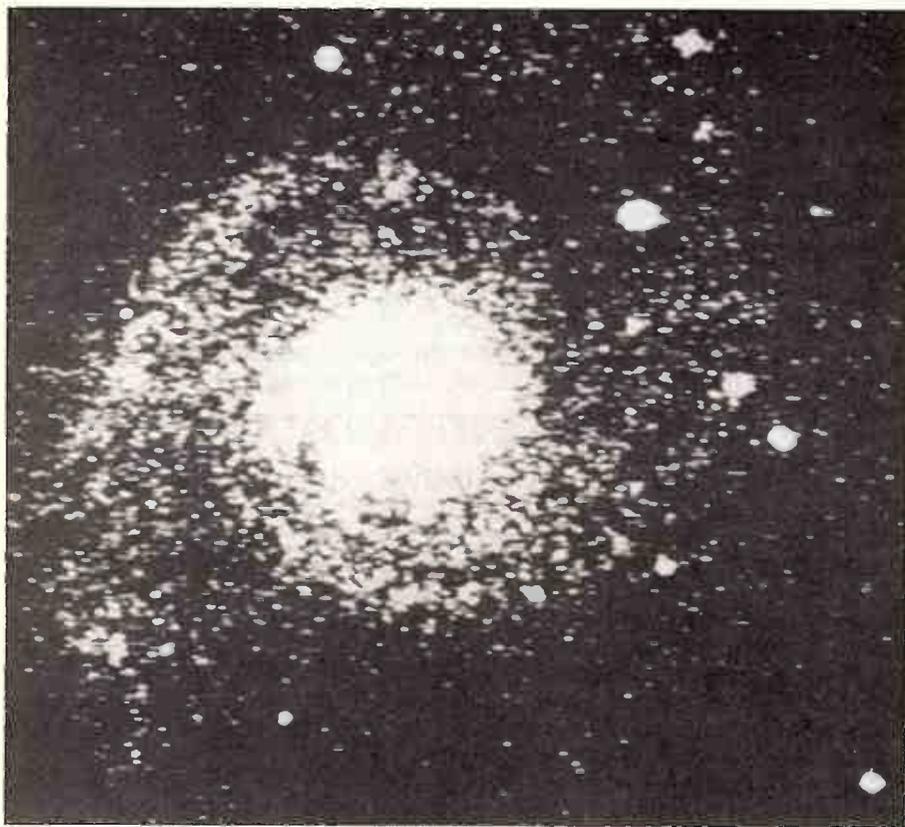
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# BRINGING DOWN THE DATA

Paul Murdin



*Television image of the Spiral galaxy M51 in a field of stars. The image is contrast-stretched and clipped so that stars appear as circles sized according to their brightness. Such an image is good enough to identify the nebula and to position the telescope on, say, one of the bright patches in the spiral arms. Its information content is much less than the original half a megabyte of data generated.*

**Astronomers are taking the first steps in operating ground-based telescopes from data centres and remote control rooms instead of travelling the world to distant mountains.**

**A**stronomers who study radiations which cannot penetrate the Earth's atmosphere are used to operating their telescopes remotely. They have had to, for such telescopes have been carried on board satellites orbiting the Earth. The International Ultraviolet Explorer (IUE) operated by the European Space Agency tracking station from Madrid, the European X-ray Astronomy Satellite operated from Darmstadt, Germany, and the Infra Red

Astronomy Satellite with its ground station in the Rutherford Appleton Laboratory in the UK, are all satellites in which astronomers have played an active part and to which remote observing techniques have been applied.

It is not so clear why a telescope on the ground has to be remotely operated. Until recently, most telescopes have been near the astronomers' bases and could be operated by the astronomers travelling to them.

But over the last 20 years astronomers have sought out places on distant mountains as sites for their telescopes, and that is why we have begun to apply space techniques to ground-based equipment.

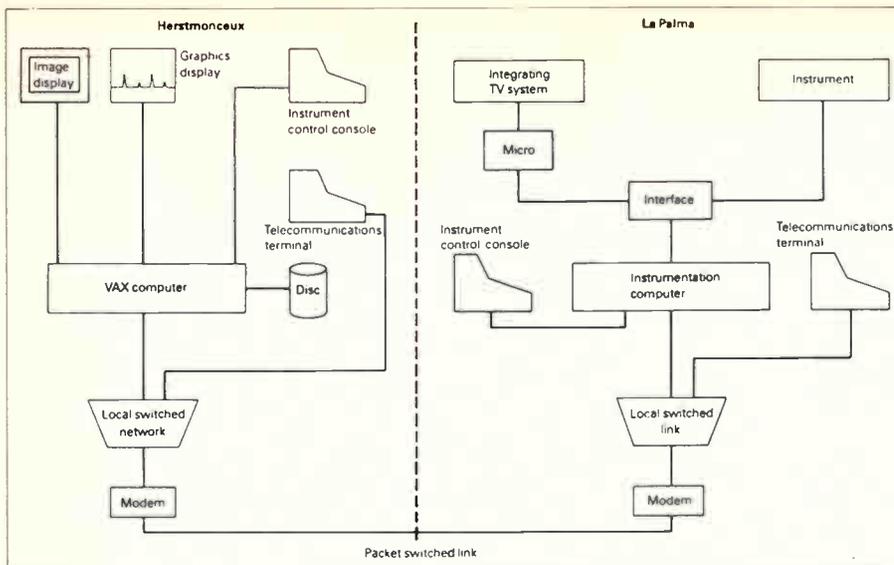
Why are we putting observatories on mountains, in distant countries and in relatively inaccessible places?

Quasars and galaxies which formed in distant regions soon after the origin of the universe emit light which carries messages about conditions in the so-called Big Bang. The light travels to us over times of the order of  $10^{10}$  years, over distances of some  $10^{23}$  km. It is considerably diluted by travelling this distance (understatement!) so, to gain information about the conditions in and after the Big Bang, astronomers have to study faint objects. Their light is perceived against a 'noise' of background light from contaminating sources such as artificial light scattered by dust, and their images are blurred by passage through the Earth's atmosphere. In this difficult study, maximum information can be gained only if the faint sources can be seen with the highest contrast, as the sharpest images against the darkest sky. These are the reasons why astronomers have built telescopes in the clear air on mountain tops, far from population centres that emit light and give off smoke.

## **Relative Cost**

The decision whether to take the telescope's control and operation system to the user, or the user to the telescope, depends upon the relative cost of travel and that of communications. Remote operations can also offer certain other advantages to the astronomer. If the observatory is very far above sea level it might be advantageous to overcome the astronomer's inefficiency in working at an altitude where oxygen deprivation can spoil judgement. One astronomer reporting on his experience at Mauna Kea in Hawaii at 4200 metres is quoted as saying "I confused the co-ordinates and pointed the telescope to the wrong place to take my picture, but that didn't matter because halfway through developing the photograph in the fixer I realised I had the darkroom lights on."

The simplest observations to make remotely are those which are repetitive and which generate simple measurements. The



Remote operations network for the optical telescope sited at La Palma.

Carlsberg Automatic Meridian Circle (CAMC) on La Palma in the Canary Islands makes observations of this kind. The instrument, jointly built by the Copenhagen University Observatory and the Royal Greenwich Observatory, is a telescope which rotates around only one axis, in a North-South plane. Its purpose is to time stars as they transit through this plane, and to measure their angle of elevation above the horizon. Effectively this measures the positions of the stars, and indeed the planets, including the one on which the telescope is mounted. Construction of a consistent model of the interrelations of the star positions, and their change from decade to decade, yields information about the motion of the Earth and the dynamics of the solar system and our Galaxy of stars.

Traditionally, transit measurements have been made by noting the time a star is seen by eye to pass behind a vertical cross hair and measuring its position along the hair. In the new technique used by the CAMC, the star is imaged on to a V-shaped mask which is scanned back and forth. Starlight passing through the mask is read by a photomultiplier: the phase information in its output yields the time of transit and the duty-cycle of the signal yields the position of the star along the V. The telescope is automatically operated by two minicomputers which select stars from a priority list held on a disc, position the telescope to catch the selected star for transit, make the measurements and reduce the data. They monitor the atmospheric conditions and cover the telescope whenever it rains; they check for cloud and malfunctions, and they make calibration measurements on a schedule. The efficiency of the telescope is such that it measures the position of 1000 stars per night to an accuracy of 0.2 arc sec. It constructs in one year a complete catalogue of star positions which would formerly have taken a decade

to observe and another decade to reduce. The CAMC operates remotely in the sense that, after it is primed at the beginning of the night, the telescope works without intervention; in fact, the astronomer operating it sleeps some distance away from it.

The longest link yet achieved in remote-control ground-based astronomy is between the Royal Observatory, Edinburgh, and the UK Infra Red Telescope (UKIRT) on Hawaii. Data streams travel by microwave link from the telescope at 4200 metres to the sea-level base at Hilo and then via a chain of packet switched networks across the USA to Scotland. This system, using the relatively low data rates of infrared astronomy based on point-by-point accumulation of data, instead of accumulation of images, has been successfully used for a couple of years.

The CAMC and UKIRT generate data at low rates. Before I describe how to operate an optical telescope remotely, let us look at how it is used.

### Use of Telescopes

A typical large, professional telescope with a mirror of about 4 m diameter is used by some 100 astronomers per year; their experience varies enormously from student

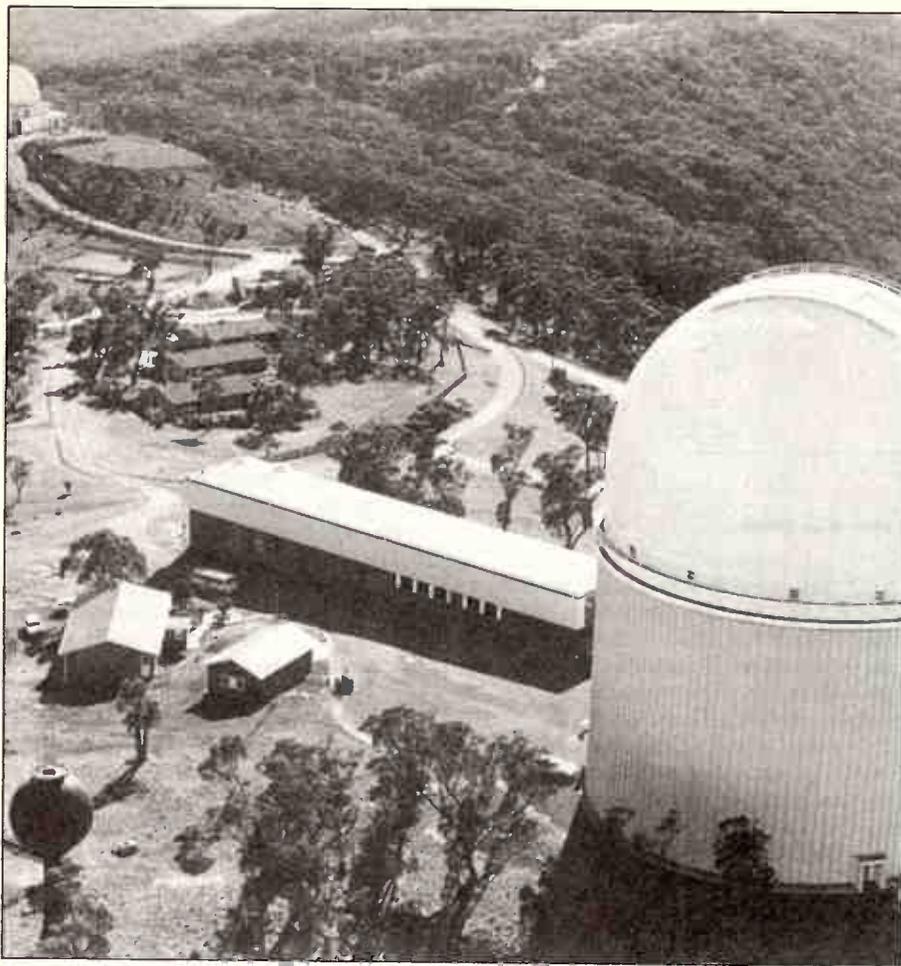
No. of transmissions	Data
80	2048 × 128-pixel 16-bit images
320	256 × 256-point 16-bit images
10 400	2048-pixel 16-bit graphs
21 600	24 lines × 80-character/line VDU screens
5200	60 lines × 132-character/line printer pages

Using a 9.6 kbit/s connection between La Palma and the UK, any of the data in the table (or an appropriate mixture) can be transmitted during a 12-hour night.

novice to old professional. The telescope is operated from a control desk some 10 m from the site by a professional telescope operator: the traditional name for this person is 'night assistant' but the radio astronomy term 'telescope driver' is also used. On a prompt from the astronomer, the night assistant causes the telescope to slew to the next star to be observed. A picture through the telescope is presented to the astronomer who then identifies in detail the object he wishes to observe and the telescope is adjusted to point directly to it. The picture is, typically, presented from a television camera viewing the phosphor of an image intensifier. On La Palma, the 2.5 m Isaac Newton Telescope operated by the Royal Greenwich Observatory uses intensified television cameras to acquire stars and the pictures can be integrated by allowing charge to accumulate on the target for several seconds before it is read, and/or by averaging successive pictures in a 512-pixel × 512-pixel × 16-bit memory. Although the picture contains half a megabyte of data, there are usually only a few significant features in it, so its information content is much less. It may be that a list of, say 10 stars, including their positions and brightness, is all that is needed to reconstruct the picture. A kilobyte will do for this.

After the telescope is positioned accurately, it is kept tracking accurately by closed-looped servos to follow the star in its rising and setting across the sky. No data is sent to any remote point in this process, which is all related locally to the telescope. But its performance is monitored by viewing reflected starlight from the entrance plate of the instrument that is being used to analyse the star, and this image is transmitted back to the astronomer. The instrument might be a spectrograph for measuring the wavelengths and intensities of spectral lines in the star. Data is produced by the spectrograph in the form of another image which is read by a detector. It would not be usual for the telescope to follow a star and for the detector to integrate on its signal for minutes or hours. Not all this integration time is available to transmit previously-acquired information.

If the detector is an intensified television system, the signal accumulates in a memory and is available for inspection during the integration. On the basis of a preliminary analysis of a partial integration the astronomer can decide what to do: for example, he may abort because what he wants to measure is not present, or integrate until the signal-to-noise ratio of a feature hidden in the spectrum becomes large enough. The Royal Greenwich Observatory's La Palma telescopes and the Anglo-Australian Telescope located at Coonabarabran, NSW, use an Image Photon Counting System (IPCS) to record data. The IPCS features image sharpening techniques and forms images made by accumulating the signals of individual



Far more conveniently located is the Anglo-Australian observatory at Siding Springs

photons. It is capable of generating images  $2048 \times 514$  pixels in area and at least 16 bits in depth, and produces more data more often and with more requirement for interaction; in fact, the IPCS is the critical test for a remote operation centre.

At the end of the integration the data is passed into a storage medium. Many astronomers would like, in their excitement, to begin detailed analysis immediately, and the scientific advantages are obvious: discoveries are made when the adrenalin is flowing.

### Various Problems

In remote operation of telescopes the cost of each of the parts of the observing sequence needs to be justified in terms of the monetary scale set by the staff travel budget which would be saved. This can be complicated. Positioning of the telescope is within the capacity of a low-bandwidth command channel (even of voice instruction!) and the only point of issue is safety of personnel and

equipment. Altering the equipment configuration and monitoring its status also requires only a low bandwidth. Acquiring the star field, finely positioning the telescope and monitoring its position need a higher bandwidth but image condensation techniques are available to present a digest of star field to the astronomer within the 60 seconds that is the longest he will tolerate. The Kitt Peak Observatory 2.1 m telescope in Arizona can be remotely operated by what is known as a travelling operation station, which uses a video expander to receive the acquisition field after it has been compressed for transmission over telephone lines. The unit, part of an analogue device that generates, transmits and receives slow-scan pictures, was developed to meet a need for remote surveillance by security staff. Digital compression and transmission is even better adapted to high modulation star pictures.

So remote control of telescopes from 1000 km away is easy, a simple extension of what is already done over 10 m. The bottle-

neck in remote operation of optical telescopes lies in data generation: the dynamic range in astronomical data, which contains information from the very bright to the very faint, raises a problem in the process of data compression without clipping, and the analogue transmission technique used in the Kitt Peak video display is not suitable.

Once remote operation at a central home station is established, one of the next steps is to extend the number of stations, thereby making it possible to link many universities into a common programme of astrophysical enquiry, each using its specialist knowledge to interact with the data and ensure that the programme succeeds. Once data from the telescope enters the system, hundreds of man-years worth of astronomical data reduction software can be brought to bear on it, wringing the last bit of information from the very last photon.

### Programme Flexibility

Remote operation of telescopes is stimulated by its technological timeliness, by frequently rising travel costs and by the efficiency it brings. It also affords programme flexibility. At present, astronomers are scheduled to use a big telescope for nominated nights and they use it 'come rain or shine'. Even if the sky is clear, it is largely a matter of chance whether the weather conditions are exactly matched to the type of observation the astronomer wishes to make; certain particularly critical observations may need special and infrequent conditions. It is not practical to house dozens of astronomers on a mountain for weeks at a time and move them on and off the telescope as conditions change, but if they can observe remotely, from their university offices, they can be scheduled flexibly and at short notice whenever suitable weather conditions become available.

The 4.2 m William Herschel Telescope, being built on La Palma by the Royal Greenwich Observatory, is the first telescope to be designed with this in mind. Its particular optical design, called after its Victorian engineer inventor James Nasmyth, incorporates a mirror which can switch the light beam from instrument to instrument at a minute's notice. At least four instruments can stand by for deployment as weather conditions and astronomical programmes change.

It may be that the next generation of astronomers will look back with amusement and perhaps envy at our present travel to distant, exotic places. After the age in which avionics technology has brought the astronomers to the mountains, information technology will instead bring the mountain to the astronomers.

*Dr Paul Murdin is at the Royal Greenwich Observatory*

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# SOUND INSIGHTS

## BASF's New Range

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- Pioneer's CD-V
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Home Entertainment Integration



### New Cinema Standard

# Sight and Sound News

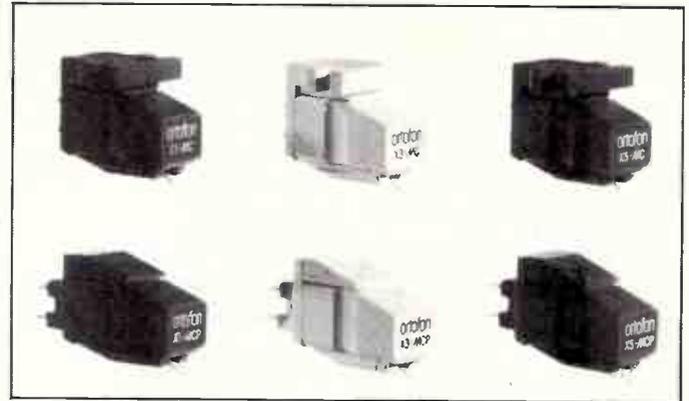
## For the Turntable

Ortofon has released a new improved MC3000 moving coil cartridge, incorporating a hard ceramic cartridge shell, slim profile, diamond stylus (the Ortofon Replicant Stylus 100) and new materials in the moving system. Ortofon claims that the new system increases the output voltage to double that of the MC2000.

To match the higher output, the company has developed the T3000 transformer, boosting the signal level 30 dB before

the preamplifier section. The T3000 is a dedicated transformer with no switches or contacts in the signal path. It uses a toroidal mu-metal core and pure silver wire coil system. The stereo channels are wholly discrete units with heavy mu-metal shielding from all forms of hum and noise. The dual mono construction eliminates cross-talk.

A new model has also been added to Ortofon's high output moving coil cartridge range with the X5-XC model. This model uses a nude FG Type II stylus to give extended frequency up to 45 kHz. All three



models in the series (X1-MC, X3-MC and X5-MC) are available as P-mount versions which

allows the use of T4P tonearms.

READER INFO No. 115

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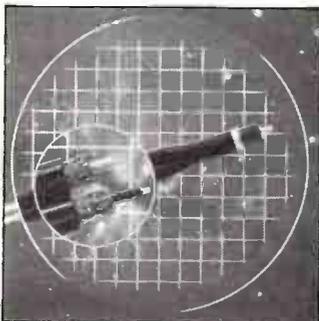
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## Unstrangle Your Cables

Unstrangle your cables is the message from Matthew Bond of Absolute Reference Audio Labs and Music by Design, who has devised a range of "Space and Time" cables meant to simulate the purest conditions for audio transmission.

Bond's Open Field Theory uses the premise that the emf (electromagnetic field) of the signal will be impeded by material surrounding the conductor, particularly materials used as fillers and insulants that have varying dielectric properties colouring the sound. He concedes that cables need to be insulated from each other to avoid oxidation so he has de-



signed cables that are loose in their jackets with limited interaction with one another. Conductors are not twisted together; multistrand cables are avoided.

The results, Bond claims, are a greater emf field strength and an extended bandwidth to upper frequencies. On the subjective side, you hear greater detail, clarity and focus; sound is "more real and open".

Five different cables have been produced. The Pandora interconnect cable consists of a dedicated signal run positive/send conductor, shielded alone in its own jacket, as is the negative/return conductor. It thereby avoids changes in the upper bandwidth information, i.e. distortions and phase cancellation, possible in twisted cable.

The Original interconnect cable joins twin balanced solid core conductors in the one jacket without twisting. Cable number three, the Standard cable, does use a twisted design and is recommended for use

with CD players.

Finally are two speaker cables. Phase I speaker cable consists of a single twisted pair of solid core conductors, using perfect crystal copper insulated in a simple material. Bond claims it has a "quieter noise floor than other cable types". The Phase II design has the positive and negative conductor runs separated from each other. The runs are double solid cores, which, Bond claims, is not the same thing as multi-strand cable and without concomitant capacitive or inductive effects.

READER INFO No. 125

## Cover

Two tapes from BASF: the E240 Super High Grade video tape and the Chrome Super II audio tape. These are representative of a comprehensive new range BASF is promoting which includes digital audio tape. BASF's campaign motif is the pink whale you can see at the bottom left hand corner.

READER INFO No. 137

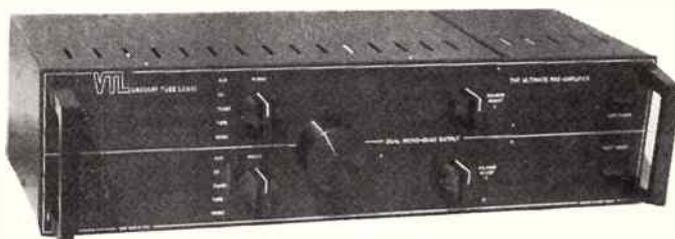
## A Small Rock and Roll Swindle

You don't need to go to Bali. For six dollars you can buy a badly copied counterfeit cassette of many of the latest hits, with your very own colour photocopied label. That's the warning being given by CBS records and the Australian Record Industry Association after receiving myriad complaints from swindled buyers disgruntled with the quality of their purchases. The line these folk were fed was the familiar but, unfortunately, plausible one of extras without proper jacketing and labelling which the recording companies wanted to get rid of.

In recent months nine people have been charged in unrelated incidents under the Copyright Act for counterfeiting tapes,

four of whom have been convicted. Fines have ranged from \$100 to \$1400 depending on the number of fraudulent cassettes in their possession. According to Mike Edwards from CBS, this is not an indication of the proportions of the operation. Dealers in these tapes, he says, keep only a small number of cassettes on hand with the bulk located somewhere else convenient. He quotes a turnover of 200 cassettes an hour at the stalls when in full swing, which, at \$6 per pop, is an easy \$3600 for a morning's work.

Even if those figures sound too remarkable, the business is a nuisance to the public, and at \$6 per cassette, they're not even exceptionally cheap.



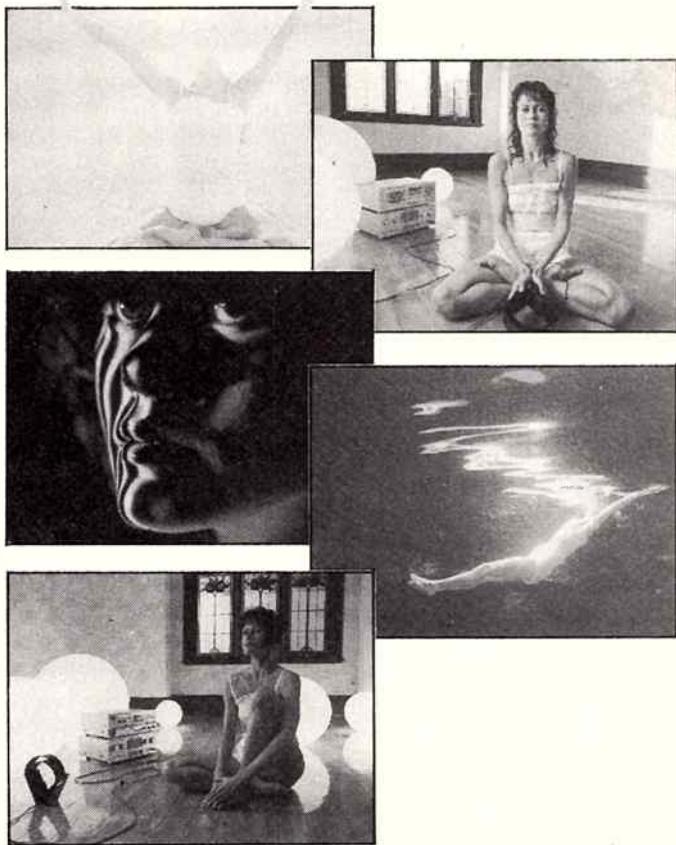
## Dual is a Challenge

Vacuum Tube Logic Australia has released a new military standard preamplifier. The rather expensive model (at \$5500) is a totally dual mono design, starting with two completely separate voltage supplies, fully regulated with independent high and low voltage power transformers stack-mounted alongside the audio unit. It also features two mains inputs and two mains switches.

The rear panel of the unit is fixed with a hinge to allow access; it also houses the neoprene shock-mount suspension phono boards for zero micro-

phonics. The amp works with 16 Gold Aero triodes to give massive gain and preset adjust controls optimise component matching. Two separately buffered pairs of low impedance outputs are available to enable QAD configuration crossover components to be fitted in spaces provided for full bi-amplification.

Separate six-input avionic selector switches are offered plus separate per-channel balance/trim controls for total channel separation. The milspec pc boards use 3 oz silver copper tracks. *READER INFO No. 118*



## TDK Does Amazing Things With Advertising

TDK has claimed to have almost 50 per cent of the Australian audio cassette market, making it the top selling brand. Australian General Manager, Ken Kihara, has attributed this success to the solid advertising campaign . . . remember "TDK does amazing things with my system"?

A survey conducted in 1986 showed an awareness of TDK of 42 per cent on an unaided basis, and also showed it was the first audio tape that sprang to people's minds.

However, in videotape TDK has claimed only number three position, its main challenge

coming from cheaper Korean tapes marketed under Japanese brand names. The strategy for tackling this is, according to TDK, another advertising onslaught emphasising quality.

Nevertheless, lower price is always appealing to the consumer, and while TDK singles out cheap Korean-made tapes, it must contend with cheap Taiwanese product, which itself is under threat from mainland China. According to a recent Japanese report, mainland China is now emerging as a large-volume supplier through Hong Kong of the lowest-priced product.

## Handy Mixer/Amp; Hands-Free Mic

US microphone manufacturer, Shure, has released two products, one to suit the mass market and the other to suit the professional. The combined 200M, a small, no frills, low-priced microphone mixer and 210A companion power amp are suitable for venues requiring low power, such as halls, churches, offices or outdoor gatherings. Twelve volts will deliver the full 10 watt output.

The Shure SM15 head-worn condenser microphone, on the other hand, is designed for the professional who requires

hands-free operation, where voice quality is critical.

### Mixer/amp

The 210A amp has a balanced, low impedance, three-pin, professional microphone level input, and two parallel, phono-type auxiliary level signal inputs. Two 1/4-inch, phono-type loudspeaker jack outputs, a pushbutton circuit breaker reset, and DC power input socket are located on the rear. At the front are the master volume and power controls. RRP is \$376.

The 200M mixer has four

electronically balanced, low impedance, three-pin, professional microphone inputs with individual level controls. One input is switchable between microphone or auxiliary via a phono-type jack input. Both outputs are controlled by the master volume control and can be used simultaneously. The microphone mixer is fully shielded against rf interference. RRP is \$419.

More than one amplifier or mixer can be chained together for higher output levels or more mixing inputs. The 210A

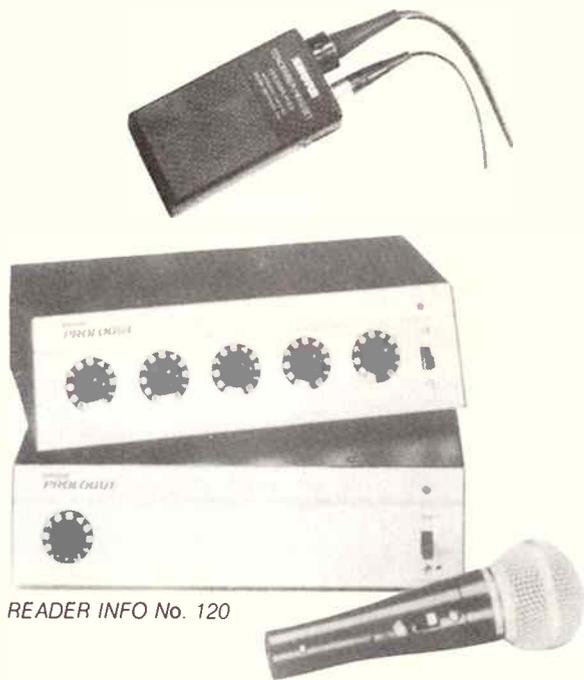
amp can be used alone when only one or two inputs are needed; when four or five are needed, the 200M should be added. Cabinet dimensions are 69.9 x 241 x 145 mm. Optional transformers are available.

### Mic

For professional users is the SM15 unidirectional, head-worn condenser microphone, designed with performing musical artists in mind, along with sports or news announcers, and for intercommunications systems.

The microphone has a fully adjustable boom pivot that locks for precise placement on either side of the head. Twenty degree boom pivot is permitted in any direction and the length can be adjusted. RRP is \$660.

The SM15's amplifier is constructed from high impact-resistant "armo-dur", a thermo plastic material and can be clipped to waistband or slipped into a pocket. Approximately 1600 hours of continuous use from fresh alkaline 9 volt batteries is available. Alternatively, it can be powered from an external phantom power supply from mixer or power supply unit providing 5 to 52 Vdc. Extensive rf and hum shielding reduces the effect of electromagnetic or electrostatic interference. Microphone and amplifier cables are available as accessories, as well as wind-screens and carry case.



READER INFO No. 120



READER INFO No. 119

## Ignoring the DAT Experts?

The TDK newsletter *TDK Today* recently crossed our desks with a selection of experts' views on DAT and S-VHS that were predominantly and surprisingly damning of DAT. Of the 13 comments that related to DAT, nine expressed quite negative opinions on the future of the medium, three were ambiguous, and only one spoke definitively of a positive future for DAT.

Setting the tone Peter Nagy, from West Germany's *Stereo*, comprehensively summed up: "Firstly, it's very expensive, and will stay too expensive for the mass market. Secondly, the recording industry does not want to release pre-recorded cassettes. And thirdly, because of the ECC-imposed anti-recording device, consumers won't be able to record their own music onto DAT, which defeats the whole purpose of

the product."

On a more consoling note remarked Stephen A. Booth of the US' *Popular Mechanics*: "DAT is as good as here already". But he went on to say "I don't believe all the necessary pieces are in place to derive full advantage from either format, and therefore make DAT or S-VHS a sensible purchase for the American consumer".

The copycode system pro-

posed by CBS records was, for the most part, seen as the main thing jeopardising the acceptance of DAT, notwithstanding credit given to the superior technology of DAT.

The curious thing about the collection of views is that TDK has been something of a high profile supporter and producer of digital audio tape.



## JVC Portable Combos

JVC has a new range of portable component systems ranging in price and complexity. At \$1089, the PC-V2 includes CD player, FM stereo/AM/SW/SW2 radio, 5-band graphic equaliser and detachable speakers. The cassette function has U-turn auto-reverse and Dolby noise reduction. Power output is 70 watts. Ports include MIC, PHONES, AUX-IN, CD-OUT.

The PC-V77 has FM stereo AM/SW radio, dual cassette, 5-band graphic equaliser and detachable 60 watt speakers.

The radio features presets and the cassette has one touch recording, full auto-stop mechanism and mixing capability. Ports include CD-IN, MIXING MIC, and PHONES. The PC-V77 retails at \$449.

Finally, the PC-V55, the cheapest at \$339 combines FM stereo/AM/SW1/SW2, 5-band graphic equaliser, auto-reverse cassette and detachable speakers. Other attractions, as with the PC-V2 are a beat cut switch and hyper-bass sound. Output power is 60 watts.

READER INFO No. 122

## Combination

Craft Audio, manufacturer of the audiophile amplifier combination, the C3/C4, has released a new pre-power amplifier combination. It consists of three units: two preamplifiers and a power amp.

The Logic 1 preamplifier is a straight line preamp. It accepts line level sources and offers inputs for CD, phono, tuner and tape. The only front panel controls are volume and balance.

A smart feature is the Auto Source Selection. This will automatically select any activated input. Place your stylus on a record and it switches to phono. Bingo! Activate your CD and voila, you have CD selected. There is an input priority so that not more than one input can be active at one time.

The Phono preamplifier is a compact unit offering high

quality, low noise, preamplification for either moving coil or moving magnet cartridges. It is not a head amp but a complete RIAA stage which draws its power from the Logic 1 preamp.

Finally, the C5 amplifier is a true dual mono power amp with entirely separate power supplies and earthing for each channel. It uses a generously sized C core transformer and as with other Craft Audio products has a MOSFET output stage.

It will drive any dynamic loudspeaker load to loud levels with its 70 watt per channel output.

RRP for the combination C5/L1/phono preamp is \$2250. If you don't have a turntable and want to dispense with the phono preamp, the C5/L1 combination price is \$1949.

READER INFO No. 121

## BRIEFS



### Handycam With Digital Memory

The CCD-V50 digital Handycam from Sony is a second generation unit to the CCD-V30. It includes the same built-in playback deck with the added features of "digital superimpose" function, a 6X power zoom lens with macro function and a date/time display system. The superimpose function and digital memory IC can memo-

rise points of high contrast from handwritten titles to three dimensional objects for use at any time.

Playback is through the electronic viewfinder or through a television or monitor. The CCD-V50 is compatible with all 1/2-inch formats. RRP is \$3125.

READER INFO No. 123

### Philips for GM and Toyota

Philips is looking happy with two new contracts. One is to supply Toyota with Concern car radio units worth approximately \$50 million over the next four years, and the other

is to supply General Motors with radio/cassette combinations worth in excess of \$10 million over the next four years.



### Videodisc Plays Both Sides

A new videodisc, the SLV-J1 player devised by Sanyo in Japan, can play back from both sides of a disc without the user having to turn the disc over. The device reverses automatically and permits random access on either side of the disc. The work is done by a single

pickup moving on a U-shaped rail from upper to lower side of the disc known as a "Jet Turn" mechanism. As yet the player has only been shown in Japan.

If you would like further information on any of the products described on these pages, circle the relevant information number on the insert and post it to ETI.

# 30 Frames: We'll see it — but will we notice it?

MANUFACTURERS of 35mm motion picture cameras are adding two unusual options to their models: 30 frames per second filming, and a three perforation pull down in place of the normal four.

This means another TV vs Cinema tussle is under way, to the glowing expectations of equipment manufacturers eager to generate another wave of profitable obsolescence.

Broadcast video is boring its audience, video hire shops are booming. In Japan and the US powerful industry wheels are rolling in the cause of High Definition Video with 1125 lines — a wide screen aspect ratio of 1.78:1 — and a 30 frames per second scanning rate.

Movie audiences appear quite willing to pay \$7-9 for a cinema seat, new theatres are rising, older ones being refurbished, and attendances are rising. The 'big' movie is gaining popularity: the horizontally-running 70mm IMAX and OMNIMAX process is now showing in 50 theatres world-wide; Showscan, a 70mm development using long-forgotten cameras and adapted still lenses gallops along at a thundering 60 frames per second.

Previously thought to have 'cloth eyes', the audience is wising up, as recently revealed by an audience survey in Wollongong, NSW. Viewers expressed a fervent preference for TV commercials shot on 35mm film when compared to Betacam and 1" tape originated productions. Similarly, cinema audiences display unease when confronted with 16mm, relaxed acceptance of 35mm — and decided enthusiasm when enveloped in hi-fi 70mm processes.

Now the film industry in the UK and US is studying a change to 30 frames per second filming and projection. Behind it is a feeling the cinema needs a technological jolt to force it not only a few squares, but a whole chess board ahead of its electronic rival. Industry interests have recently realised that, aside from Dolby stereo and more comfortable theatres, little has been done to 'brush up the act' of the average movie house's product since WW2.

Since the advent of sound the framing rate has been 24 frames per second, enough to supply an adequately faithful

recreation of the original action. When sound came in, the silent cinema's irritating 18 fps flicker disappeared almost overnight, and audiences appear to have been content ever since.

Word of mouth on 60 fps Showscan has it that the reproduction is stunning. Strangely, the lack of flicker rarely raises comment — but clarity, apparent sharpness, and the illusion of stereoscopic depth emerge as very real, qualitative comments.

In video, the story has an international bias. Ask any North American reared on NTSC for his opinion of our 'superior' PAL system. Annoying flicker is usually the most pungent comment. According to them, whether viewed in Europe or Australia, the 25 fps PAL picture just doesn't stand up in the flicker stakes.

Flicker is a fickle thing. A Sydney studio in the sixties possessed two glorious, bronze Rank Kalee projectors delicately lifted from an abandoned drive-in theatre. As the lens to screen light throw was all of 8 metres the picture was blinding, with any brightly lit scene calling for sunglasses, and panning shots resembling a badly engineered AV.

Flicker is noticeable to the average person. Sitting too close to the screen, or an overly bright light source will reveal its presence. In the USA screen brightness is double that of theatres in the UK; producers frequently comment that their films look much better in Stateside theatres.

Moving from 24 to 30 fps would eradicate the effect. Projectors running at 24 fps usually have a two bladed shutter, giving effectively 48 images per second; 30 fps with a double blade would result in 60 images — a 20 per cent reduction in flicker, and beyond human perception.

It has been said that we have been conditioned to accept 48 images per second by the mains. 50 cps mains frequency servicing our house lighting and video screen means that we don't 'see' flicker.

The TV set's brightness may in fact be set brighter than the cinema screen. Properly adjusted we can achieve a pure white with excellent colour saturation on the home set. Colour prints made for cinema, on the other hand, must be kept 'thin' to comply with the lower light levels attain-

able from Xenon light sources coping with long throws; colour saturation of course suffers. An increase in the framing rate would raise screen luminance, giving richer colour — and higher contrast/sharpness.

Mike Todd's process Todd-AO, used originally on 'Around the World in 80 Days', began as a 30 fps process. Showscan, with a single blade shutter, throws 30 foot lamberts on to the screen — 90 per cent more than the US standard, and 250 per cent more than that prevailing in the UK — and possibly Australia.

Showscan's sound has been removed from the film itself, being reproduced from a bank of compact disc players, synchronously linked to the projector.

Reproduction from a 30 fps optical print would increase frequency response to a top of 12,500 Hz; Dolby currently gives an upper limit of 10,000 Hz. The young ear would get most benefit, of music particularly.

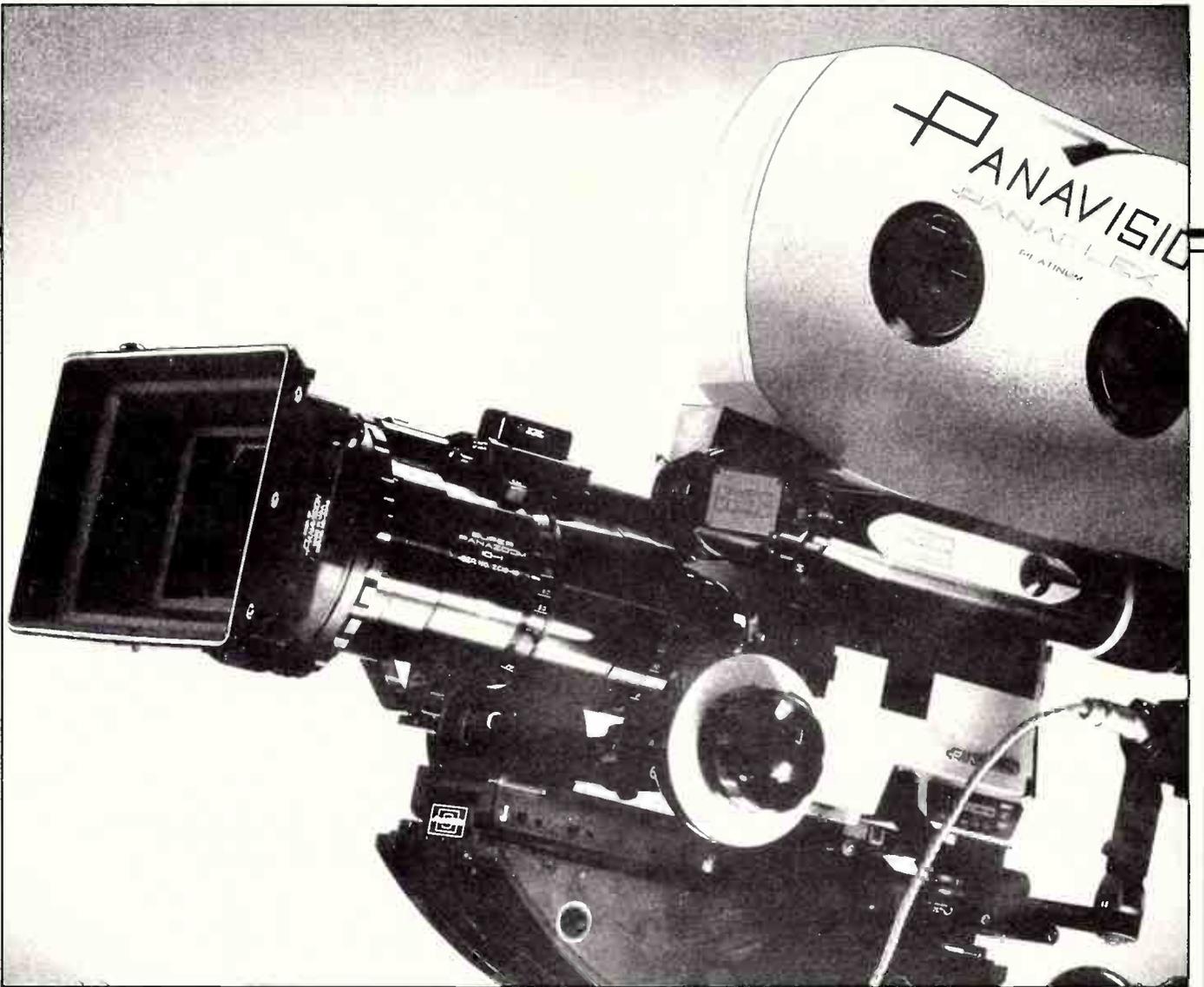
## HDTV

The US mains frequency of 60 Hz provides strong motivation for 30 fps filming, and for the 60 fields per second HDTV video system. But one wonders whether all the cost and fuss would be worthwhile. The latter is seriously being proposed as an alternative motion picture process, with the original image captured on videotape and a final transfer to film for conventional projection.

Having seen a demonstration of HDTV — via film, I came away unimpressed. Colour was poor, definition so so, and image movement showed distinct lagging and smearing effects. For a camera/recorder set-up the cost is over \$1,000,000.

30 fps motion picture shooting would be a very appealing proposition to the shareholders of Kodak, Fuji and Agfa — and a prospect of gloom for film financiers, already under siege from equipment hire, talent and crew cost increases.

Camera noise would probably increase. Ask any film sound recordist the name of a completely silent sound camera and he'll probably turn up his toes and levitate to the heaven that all sound men aspire to — Noiseless Nirvana.



One of a number of cameras now adaptable to cope with 30 frames per second filming: Panavision's grandly named Platinum Panaflex.

24 fps film-making in 50 Hz countries has only just managed to accommodate Halogen Metal Illumination (HMI) by paying scrupulous attention to framing rates, shutter angle and power supply stability. The benefits of the high output luminaries are immense. 60 Hz countries will benefit hugely from 30 fps shooting, allowing easy integration with HMI illumination.

50 Hz film-makers will pay a penalty of 2/3rd stop on their camera lenses with HMI lamps lighting a 30 fps scene. The alternatives are portable 60 Hz generators or converters, or to double the angle of the camera shutter to 216 degrees — in the process introducing blur into frames of fast moving action.

A supposed benefit of the higher framing rate would be less strobing of rapid trans-screen action, with the famous

spoked chariot wheels rotating in the direction designated by their ancient Roman creators.

In the US film-making for TV is frequently on 30 fps — for commercials and high quality features, allowing a 1:1 electronic transmission. Originally filmed or taped 24/25 fps material goes through a clumsy process of frame doubling to remove the 6 or 5 frame disparity. The latest series of 'Dallas' has been shot at 30 fps on 35mm film, with the aperture masked to HDTV's 5.3:3 wide screen ratio — will this mean JR is to have his final triumph on the bigger screen?

50 Hz countries would now face the unpleasant fact of 30 fps film material going through the reverse to allow video transmission, probably by deleting each 5th frame.

(Todd AO's lensing of 'Oklahoma' was

accomplished in both 24 fps and 30 fps — nearly doubling the shooting schedule. Obviously, for Mike Todd a little trickery with step-printing was not good enough for his vision of high tech movie presentation.)

Projectors worldwide would need to change, either by adding a ratio to the gears, or altering the power supply to make the machine run faster, with all the attendant wear and tear problems. An elegant solution to this problem could cost as little as \$800 to make the adaptation.

Prints could, and would, need to be made on thinner polyester stock allowing existing feed and takeup spools and holders to be used. Perforation damage at the high speed could thus be avoided.

In May, 1986 the English BKSTS society, conducted their own study of the pluses and minuses of a 30 fps system.

Their findings homed in on four specific phenomena:

**Motion Portrayal**

Lateral motion will appear to be smoother, more complete. Persistence of vision will be less important to fill in the gaps. Higher film traverse will lead to a shorter exposure per frame — giving sharper rendering of motion.

The chariot wheel effect of wheels rotating in a reverse direction will be alleviated. Faster framing rates record more positions of the spokes in each second, allowing a truer plot of the wheels' rotation.

**Flicker**

Even in the silent days flicker was objectionable, needing double or even triple bladed shutters to be used in projectors. Involved in this effect are screen brightness, shutter angle and viewer/screen proximity. The eye is also more sensitive to flicker at the edges, or peripheral area of vision — an excessively wide screen will exacerbate this effect.

**Grain**

Unlike still photography, grain in the movies has never been an acceptable ele-

ment. 30 fps would decrease apparent graininess.

**Resolution**

Resolution in 30 fps filming should improve due to grain and motion portrayal being improved.

London saw 30 vs 24 fps tests being conducted in May, 1986. Identical subject matter was photographed on Eastman Color at both 24 and 30 fps. Test subjects and actual scenes were recorded, to accomplish subjective comparisons of motion, resolution, grain and flicker. Projection was in a 2,000 seat West End theatre from identical projectors, masked to a 1.75:1 wide screen ratio. Screen luminance was 24 foot Lamberts, higher than both US and UK standards. An audience of 69 recorded their comments.

And the results: Little or no difference was noted between the two framing rates. Motion portrayal was regarded as being better in the 30 fps version, but both were criticised as still wanting. Comments ranged from 'Slightly Better' to 'Better'.

Flicker in brightly lit areas was remarked as being noticeably improved in the 30 fps film, almost unnoticeable in mid tone and dark areas.

Graininess was perceived as being

slightly less at 30 frames.

Resolution was slightly improved.

The most interesting comment from the trial was that motion portrayal was inadequate at both speeds, calling for the use of an even higher camera speed.

To this there could be two answers: adopt Showscan's 60 fps — or increase the numbers of blades in the projector's shutter.

So, the war progresses. On the one hand, there is strong and rational opposition to HDTV in Europe; on the other, there is a genuine acceptance by interests on both sides of the Atlantic that the cinema needs 30 frames — or a reasonable facsimile that will ensure film's supremacy in the quality stakes.

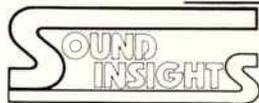
It seems we are unlikely to see our cinema screens return to the 1.33 or 1.66 to 1 ratios of yore; how long will it be before TV bows to audience and industry pressure and gives its viewers what they think they need?

In all of this, neither the film-makers nor the audience have very much influence on the matter. Vested interests will not only start the ball rolling, but construct the highway along which it will travel. You and I will be able only to wait and watch.

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22	47	72	97	122	147	172	197	222	247	272	297	322	347
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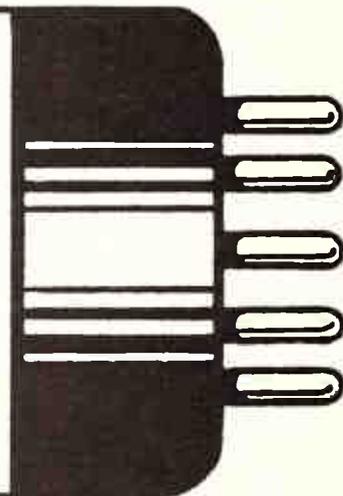
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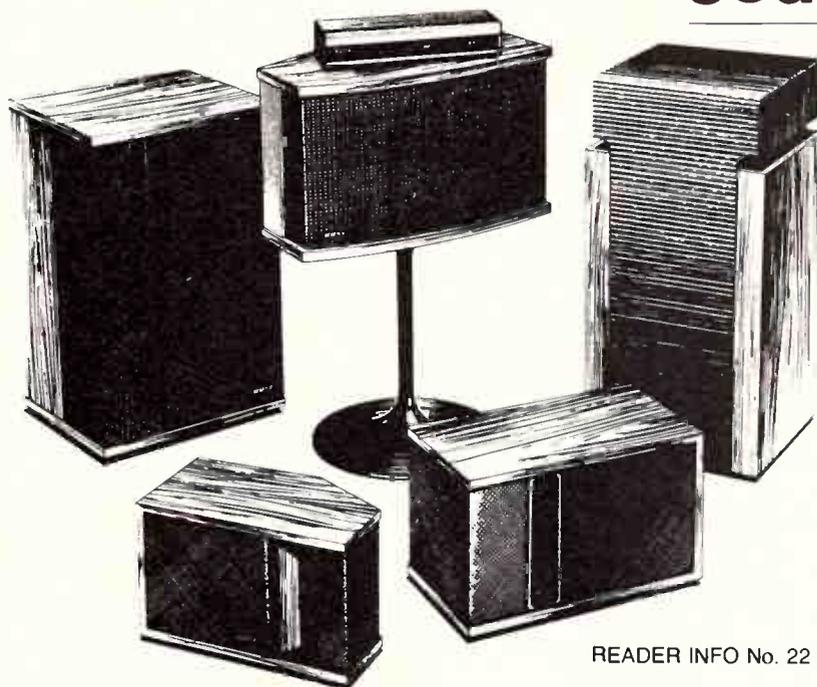
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**Bose Australia Inc.**  
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**BOSE®**  
Better sound through research.

The new trend in domestic electronics is towards integrating discrete components into a single entertainment front which operates at the flick of a remote control button. Components are matched for appearance and performance so that all your audio and video comes to you with consistent quality, at the same time dispensing with messy cabling. Systems vary in sophistication to include matched single brand units as well as those that integrate and control different video and hi-fi devices anywhere in the house.

# Integrated Systems

YOU CAN, RIGHT now, have pictures and true high-fidelity sound delivered to every room of your house, with not a cable in sight and all controlled with the press of a single finger from wherever you happen to be sitting — or lying. But you had better be well heeled. Such a system, as marketed by some of the big names in hi-fi, is unlikely to leave much change from \$20,000, and it could cost you a heap more.

Nakamichi of Japan, for instance, has recently introduced a concept of remote sensors for use with its top-line "7" series of hi-fi components. Up to six sensors can be placed in different rooms of the house — or even out in the garden shed or pool cabana if that's what you want: the sensors will operate up to 100 metres from the Nakamichi CA7 II pre-amp which is the heart of the system.

The sensors can be table- or wall-mounted and allow you to control volume and switch on or off any component linked to the pre-amp, even though you are in one room and the gear itself is in another.

All the components involved have to be Nakamichi. The full "7" series package includes the CA7 II, the PA7 power amp, the ST7 tuner, OMS7 II compact disc player and the famed CR7 cassette deck. This package would set you back some \$17,000.

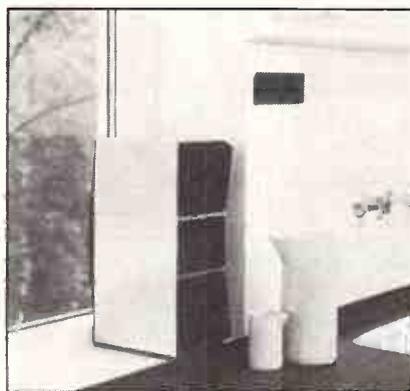
On top of that, if you are planning a multi-room installation you would need extra speakers. To do justice to the system, you would probably want to budget \$2,000 to \$8,000 for the main speakers, and \$500 to \$1,000 in each additional room. The sensors cost \$340 each, and cabling and installation are extra. So you would need something between \$20,000 and \$30,000 for a complete installation.

## Magnificent Systems

There's no doubt you would get magnificent sound, as long as you choose your speakers wisely. Nakamichi is justly proud of its "7" series, especially the CA7 II which it describes as the first remotely-controlled amp that doesn't sound like a

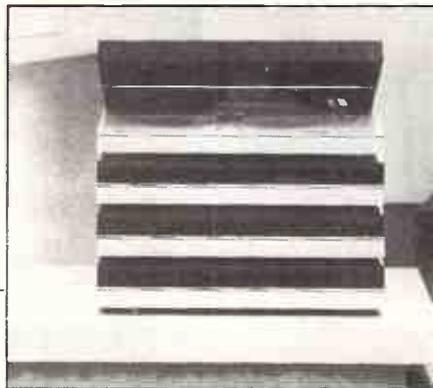
remotely-controlled pre-amp. Incidentally, any Nakamichi component that works via remote control — even the earlier decks that used corded remotes — can be connected into the system.

The Nakamichi system is audio only. A slightly different deal in multi-room audio-video is offered by Luxman with its U-100 remote control system. The U-100 is a "control centre" — a device about the size of a tuner or a graphic equaliser — which



**The muted lines of the Bang and Olufsen Beolink System. In one room the Central Beosystem 5500. In the rooms of your choice the audio and video outlets and remote control. The compact, discreet master control link mounted on the wall receives and relays the infrared control signals to the central Beosystem 5000. Generally, the master control link must be present in each room connected to the Beolink System, except, of course, in the room housing the central system. Sound and pictures can operate in different rooms simultaneously and a flick of the remote control or master link activate, mute, record, or change tracks with luxurious ease.**

READER INFO No. 130



links the various components in Luxman's high quality "Brid" range, including amplifier, tuner, turntable, cassette deck and CD, and allows them to be controlled by the one remote. As with the Nakamichi system, you can buy speakers and sensors for other rooms, and you can then use the remote control from any room.

Thus, not only can you listen to music in other rooms but you can switch between CD, tape, radio and phono, control the volume, program CD tracks, etc — you have a full range of control over all mechanical and electronic functions. But the U-100 doesn't stop there. As well as the five inputs for the Luxman Brid range, there are 11 more inputs for any non-Luxman components. For these components the remote will control only volume level and function — that is switch the thing on or off.

Eleven is more than most people are ever likely to need. You could, for instance, switch in a TV monitor, two video cassette recorders, a second tape deck, an extra turntable, and — when they become available later this year — a DAT (digital audio tape) recorder and a CD-video player — and still have room for more.

The U-100 costs around \$700, while the RC101 external sensor is \$119. If you're into surround sound, you might prefer a variation called the Luxman F105: it has all the features of the U-100 but adds time-delay surround, Dolby surround, matrix surround and simulated stereo, along with an inbuilt 25-watts per channel amp for the rear speakers. The F105 sells for around \$1200.

## Danish King

While Luxman and Nakamichi are making some inroads into the market the undoubted king of the audio-video integration scene is the Danish concern Bang and Olufsen. It has been pioneering the field for the past six years and now offers a micro-processor-controlled multi-room system of surpassing excellence — and, alas for us consumers, surpassing prices.

You won't find B&O gear in your local Target or Harvey Norman: nor even in

## DAVID FRITH

The principle behind the sophisticated integrated systems such as the Nakamichi, Luxman, Bang and Olufsen, and the Audio & Video Design systems is of a main controlling unit, possibly the amplifier, integrating the operation and control of various audio and video components; this is done with the assistance of an infrared remote control. The system is expanded with the location of sensors throughout a premises, which relay commands transmitted by the remote control to the central controlling unit. Expansion of the system naturally requires installation, cabling, extra speakers, monitors and TVs.

The different systems vary in com-

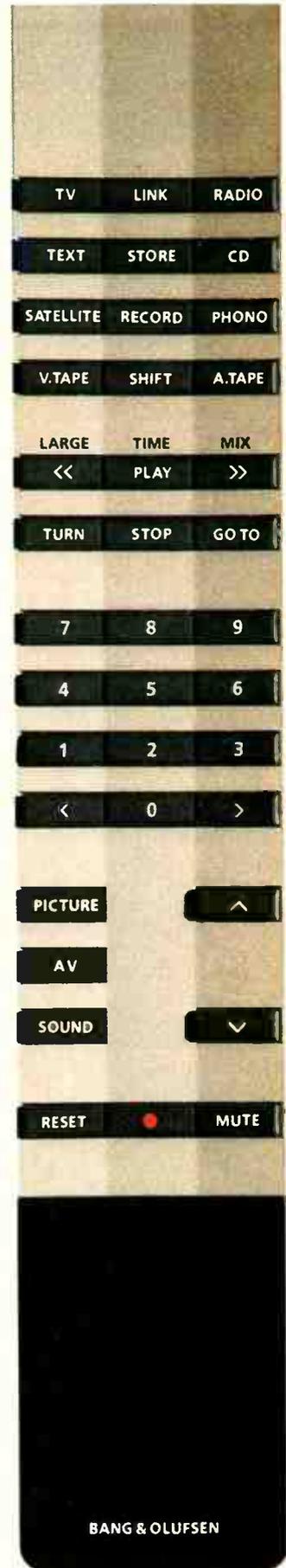
plexity and features. Some control audio and video, some only audio; some allow simultaneous operation of all components, some allow only audio or video. Some systems operate only with that company's equipment; some are compatible with other brands.

The principle behind the simpler systems such as the Sharp or Yamaha systems is to integrate the operation of audio components in one room. Sharp likes to present the complete system, a neat, easily controlled integrated home entertainment centre. Yamaha likes to underline the expandable nature of its system, suggesting you build up your system as you want.



The Nakamichi "7" Series is an audio system only. The full system consists of preamp, amp, tuner, CD, cassette deck, sensor and remote control. Up to six rooms can be fitted with sensors relaying commands back to the heart of the system, the preamp.

READER INFO No. 131



your friendly specialist hi-fi store. You have to go to Bang and Olufsen's own shops, of which there are only two in Sydney, two in Melbourne and one in Adelaide.

B&O is sometimes accused sneeringly by audiophiles of making gear for its looks rather than its sound. Few would doubt that its clean, sculpted Scandinavian lines are the best-looking in the business — a number of B&O products are after all on permanent display in New York's Museum of Modern Art, but many would argue that, dollar for dollar, better sound can be obtained by buying individual components from other specialist makers.

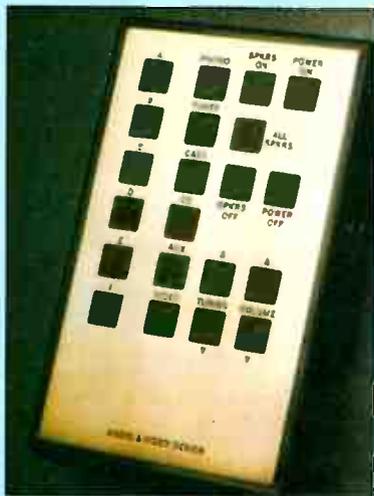
Perhaps that's so, but the general technical excellence of most Bang and Olufsen products should not be overlooked. If aesthetics are important to you, and money is no object, the Danes are well worth examining. And in this particular field of off-the-shelf audio-video integration, they are well ahead of the rest of the field.

Consider the Beolink 1000 remote control system. Not even the Nakamichi or Luxman systems approach its capabilities. A small discrete wall panel in each room relays commands from B&O's 5500 master control or the smaller 1000 remote control — the best and easiest to use control panels in the business — to audio and video units anywhere in the house. Both sound and pictures can be relayed and controlled anywhere, even simultaneously.

For instance, you can watch TV in the living room, while the rest of the family watches video on a satellite monitor in the family room, or your son listens to compact disc at full volume in his bedroom. A click on the remote control and you can switch to any other component — radio, tape or record. You can switch from track to track with consummate ease — on turntable and tape player almost as easily as CD. You might be listening to FM music in the kitchen, hear a track you like — and with a quick click on a button you're recording it on the tape player in the living room.

There's a timer switch built into every wall-mounted sensor panel. So you can program it to wake you to music at 6 every morning. One touch on the master control link will mute the system, letting you sleep in on Sunday morning; another touch on Sunday night resets the clock for Monday morning. A hidden relay box provides the connection between the central system and the extra speakers and/or TVs involved.

Bang and Olufsen make TVs and video recorders that are every bit as handsome as their audio gear and deliver superb quality pictures. Top of the range is the

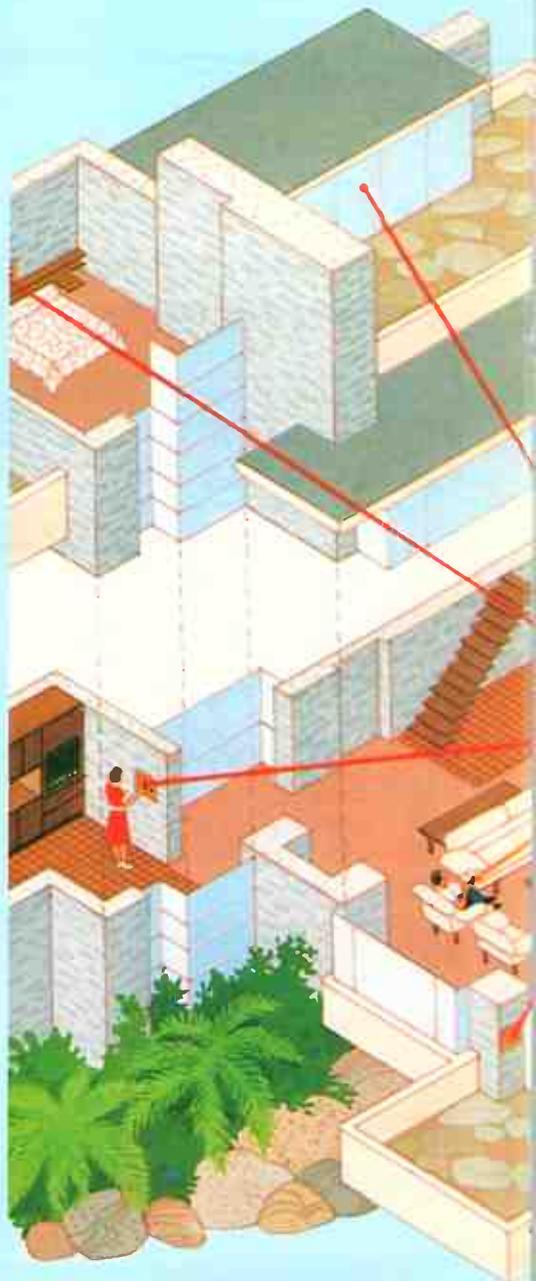


**The Australian company Audio & Video Design provides a control system for your hi-fi, video, lighting, curtains, in fact many other devices. The digital control allows different music in different rooms simultaneously. You can switch between turntable, tuner, cassette deck, compact disc, auxiliary or video in one room without affecting selections in any other room. The A&V Design systems integrate components of your choice rather than a particular brand of components.**

READER INFO No. 132

**The centrepiece of the Luxman integrated system is the F-105 A/V surround and remote control centre. The device provides inputs for Luxman Brid Series components plus 11 other inputs for non-Luxman components. It also provides surround sound. Sensors are available to expand the system into other rooms where it can be operated by the remote control.**

READER INFO No. 133



# Creating new records:



When you hear your record collection using the new Ortofon MC-20 Super you will most certainly listen with renewed interest; almost as if you were hearing each album properly for the first time. As the world's most experienced manufacturer of moving coil cartridges, it is not surprising that the Ortofon MC-20 Super - with extruded aluminium housing, Van den Hul type 1 stylus and pure carbon damping plate - delivers more tonal accuracy than can be obtained from current compact discs. To hear is to believe, as the following will indicate:

"... an Ortofon MC design that's so good it's scary. The MC-20 Super produces measurements that should keep all the spec freaks at bay ... reaffirming Ortofon's position as a manufacturer of superb cartridges at realistic prices. The MC-20 is a star."  
Hi-Fi News & Record Review, February 1986

"I can describe the overall sound only as incredibly sweet and lucid with a particularly good top end that had a lustre without the slightly overblown character of some moving coil designs ... I think I've said it all - the Ortofon MC-20 Super is a superb cartridge!"  
Ralphie Neill, Australian Hi-Fi, December 1986

"... the response was impressively smooth, flat and extended. Sound quality was very inviting ... Attractive clear and open sounding. In many ways its performance can approach the much more expensive exotic models."  
Hi-Fi Choice, 1986

"The MC-20 Super produced a convincing sound stage accompanied by an awesome sense of space and depth. The frequency balance is as near perfect as I have experienced from analogue disc playing equipment. The MC-20 Super bass simply extends smoothly and cleanly to below audibility, maintaining detail and separation at the lowest frequencies rivaling compact disc!"  
Graham S. Mayor, Which Compact Disc, 1988

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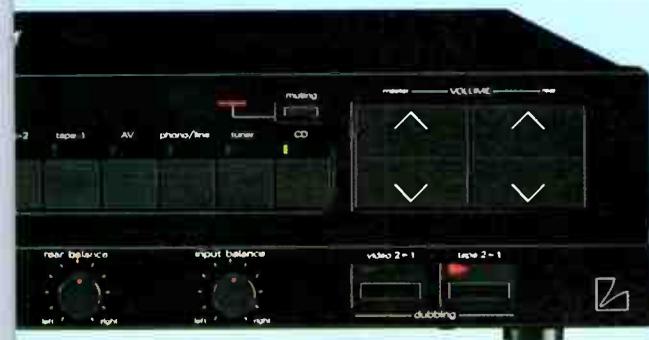
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accuracy in sound

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SOUND INSIGHTS, MARCH '88 13





With the Yamaha AVC-30U stereo amplifier you can build your own integrated system as funds and desires dictate. Two stereo inputs and outputs are provided for both audio and video signals. Audio inputs are provided for CD player, turntable, deck 1, VCR1, deck 2/VCR2, aux, tuner, and video disc player. A facility is provided for recording independent video and audio signals simultaneously, as well as monitoring another source while recording. The RS-integrated remote control directs all compatible RS components, ie, turntable, cassette deck, tuner and CD player and three built-in surround processing modes provide surround sound.

READER INFO No. 136

Catering for those who don't want the ambitious systems of music in every room but want a stylish neat integrated system are the various Sharp systems. The Calais VI system is its top of the range system, comprising 66 cm<sup>2</sup> screen stereo TV with on-screen programming facility; a hi-fi VCR with in-built stereo TV tuner; 80 watt rms per channel hi-fi system with turntable and CD player; and contemporary-styled black and chrome furniture piece. All components of the system are operated by a remote control handpiece. The Calais system is available from selected stores only and retails for around \$7500.

READER INFO No. 134

More flamboyant are the newly introduced "Fashion A/V Systems", they are shelf audio systems combined with colourful TVs in either 34 cm or 48 cm screen size. The TV sound (monoaural) is linked through to the auxiliary input of the audio system amplifier for better audio quality. The systems should find places in the family room, den or study.

READER INFO No. 135



LX2800 70cm (28in) roll-around model, with side-mounted bass reflex speaker system. The speakers (10cm woofers and 5cm tweeters) are good enough to serve as auxiliaries for the hi-fi audio system — and since all sound sources from the central system can be broadcast through the set, Bang and Olufsen suggests using the TV for just this purpose in a family room or kitchen area.

Costs? Ah, yes. A Beosystem 5500 — turntable, CD, 60-watt receiver and tape deck, plus its master control panel — \$11,600. An alternative would be the one-piece Beocentre 9000 which comprises CD, tape deck and 30-watt tuner-amp in the one sleek aluminium and glass cabinet at \$5990.

For each additional room linked into the system you need a master control link, comprising a relay box and the wall mounted sensor "eye", for \$490. The Beovision LX2800 TV costs \$3890, plus \$100 for its roll-around stand; matching VCR is \$3200.

On top of that, of course, you need speakers for each room. Bang and Olufsen naturally suggest its own Beolab Pentas — slim, graceful five-sided towers, each containing four 13cm woofers and four 8cm mid-range drivers symmetrically placed round a 2.5cm tweeter, plus a 175 watt amp for extra driving power. As the main units they are a cool \$8800 a pair. This model, along with the smaller \$5400 Beovox, has the advantage of a built-in display panel which reminds you which source is playing. B&O has other speakers ranging in price from \$650 for the subsidiary rooms. But any speakers could be linked into the system.

Add that little lot up, and the price for a three room audio-video system, using Beolab Pentas in the living room, a Beovision TV in the family room, and a \$400-\$500 pair of speakers in the bedroom, and including installation, would come to around \$29,500. If you have that kind of money to spend and want to support local industry, an alternative to consider is one of the top-notch Australian companies springing up which specialise in custom installations.

### Australian Alternatives

One such company is Sydney-based Audio and Video Design, headed by Scott Rippon. In conjunction with Sydney hi-fi dealer Len Wallis, A&V has completed many domestic and commercial installations on Sydney's North Shore.

At the heart of these systems are unique control panels, designed by Rippon. There's one of these panels, each contain-

ing mini power-amps and microprocessor controls — a "brain", as Scott Rippon prefers to call it — in each room.

You can switch between CD, tape, FM, LP or video in any room, changing the selection, turning it up, down or off, with a click on a remote commander. And — nice touch — when you do switch, for instance from CD to FM, there's no sudden change: the electronic brain gently fades one source out and the next source in. Digital circuitry and the mini power amps ensure the music is always distortion free.

With a separate amplifier for each room, the A&V Design system allows something that B&O doesn't: different audio sources in each room. You can be listening to FM classical music in the living room, while the rest of the family bops to CD on the terrace, for instance.

Scott Rippon estimates minimum cost of an audio system of this type, piped into five rooms at \$15,000. "But to really get cooking, you need to be thinking of \$20,000 and up. Yes, it's expensive, but the result is a really superb entertainment complex," he says. Could you get away more cheaply? Yes, says Rippon, if you are prepared to compromise: a system based for instance on good quality Kenwood gear, and with simple on-off switching and volume control in each room could cost between \$6,000 and \$10,000. For those who really want to expand, the sky is the limit.

Not only audio and video, but also low voltage lighting, swing down projection TV screens, curtains, security devices, telephones and intercoms can all be incorporated into the one pervasive system.

Yet all cables are carefully concealed: flush wall and ceiling mounted speakers are used — to all intents and purposes the system is invisible.

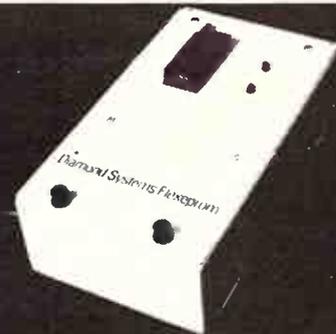
The Electronic Cottage lives, after all.

*David Frith writes on audio and video for The Sydney Morning Herald.*



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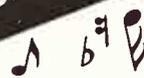
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# Dali 40 High Fidelity Loudspeaker



DALI SPEAKERS ARE undoubtedly one of the most interesting, but typical phenomena of the 80s, coming as a result of Peter Lyngdorf's commitment and a large number of hi-fi shops in Denmark which provided the wherewithal for Lyngdorf to start his own loudspeaker manufacturing company.

We have previously reviewed two Dali speakers, the first being the Dali 8 in May 1986 which impressed me but which exhibited considerable colouration and cabinet resonances, and the second, Dali 3A. These I reviewed in 1987 and commented on very favourably because of their cost benefit.

Dali now has a much larger arsenal of products and many of its speakers offer exciting performances. The Dali 40 loudspeakers are the new flagship of the Dali line. The design philosophy underlying them bears many similarities to the Duntech Sovereign 2001 Australian-designed speaker system. They are relatively tall speaker systems, with vertical arrays of loudspeakers and woofers at the top and bottom flanking mid-ranges and a single tweeter in the middle.

When the Dali 40s arrived at my office I soon discovered that these speakers are amongst the heaviest that I have had to handle in recent years. Their weight alone (68 kilograms unpacked) discourages frequent movement.

The cabinet itself is then provided with external stiffened black anodised aluminium corners to improve both the appearance and stiffness of the cabinets. The front of the cabinet and the array of speakers are designed to be covered by a light-weight frame with a black, acoustically transparent cloth cover.

The woofers are unusual, with a four-layer copper voice coil and heavy ceramic magnet assembly mounted on an aluminium split. This is formed with a supplementary inductance cancelling aluminium ring to reduce the voice coil interaction and absorb any currents that would otherwise be generated at the rear of each speaker. Because of the long throw of the speakers, its conventional dust cover has been replaced by a thin netting dust cover to allow the speaker cavity to breathe when pumping under high excursion conditions. The woofers have a 25 mm peak-to-peak excursion capability and this

## DIMENSIONS

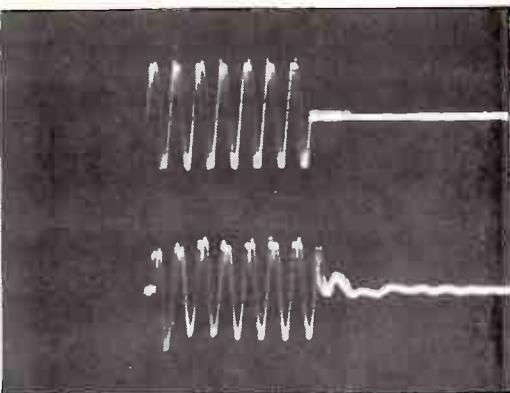
Height.....1240 mm  
 Depth.....480 mm  
 Width.....380 mm  
 Weight.....68 kg each  
 RRP.....\$7990 pr

**Louis Challis**

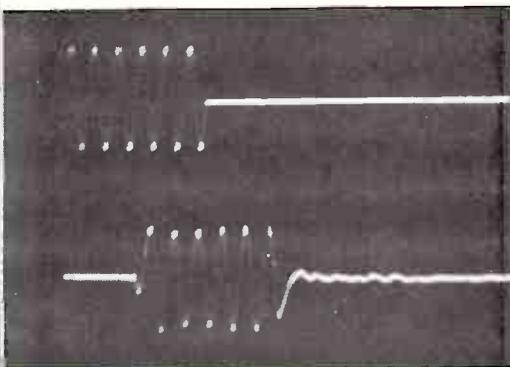
is just about the highest excursion that any 250mm diameter driver currently produces.

With such a high level of efficiency from the woofers, Dali had to develop a new set of mid-range drivers which have a most unusual appearance. The central pole piece in each of the mid-range drivers has been extended out as a tapered cone

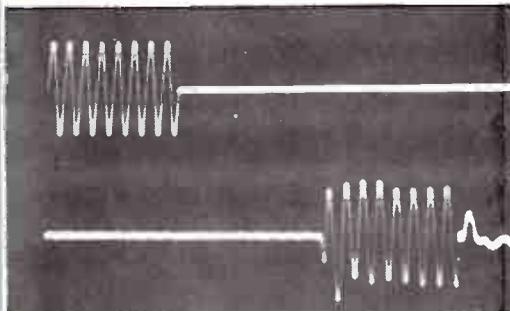
100 Hz



1 kHz



6.3 kHz



Tone burst response. Upper trace is electrical input and lower trace acoustic output.

## LOUDSPEAKER DATA SHEET

MEASURED PERFORMANCE OF: DALI 40

SERIAL NO:

FREQUENCY RESPONSE:

CROSSOVER FREQUENCIES: 900Hz - 3.1kHz

SENSITIVITY:

(for 96dB average at 1m) 8.6 V r.m.s. = 18.5 Watts (nominal into 4 Ohms)

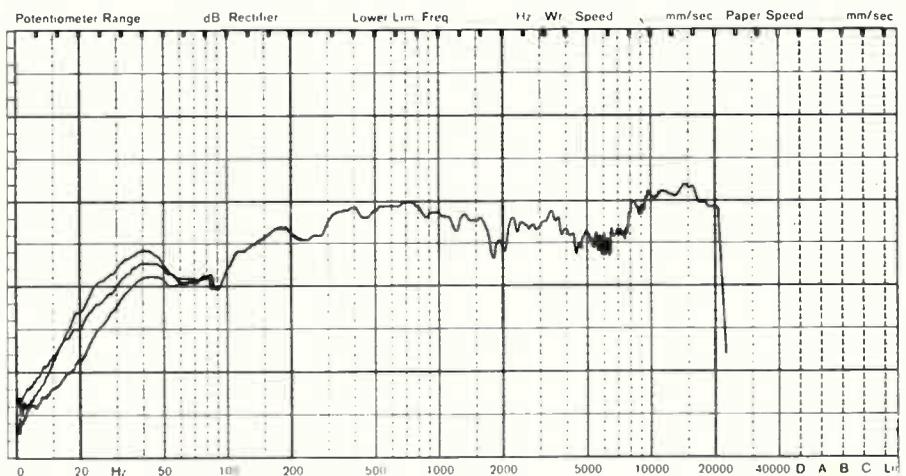
HARMONIC DISTORTION:  
 (for 96 dB at 1m)

	(96dB) 100Hz	(96dB) 1kHz	(90dB) 6.3kHz	
2nd	-38.5	-55.9	-43.9	dB
3rd	-49.5	-62.6	-56.4	dB
4th	-57.2	-	-56.6	dB
5th	-58.2	-67.1	-	dB
THD	1.2%	0.18%	0.67%	

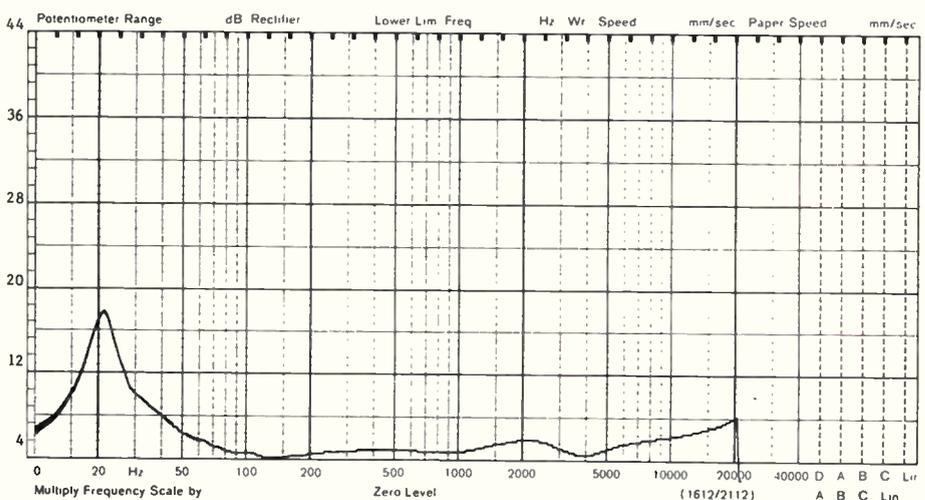
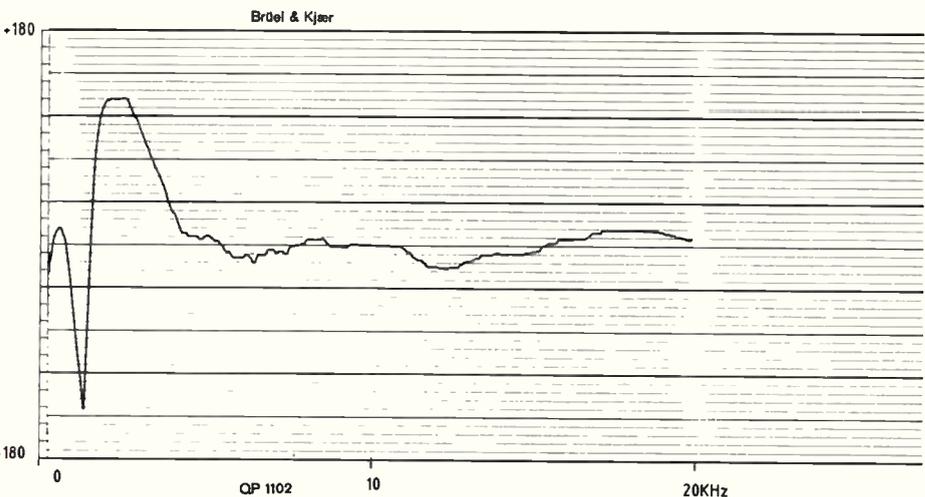
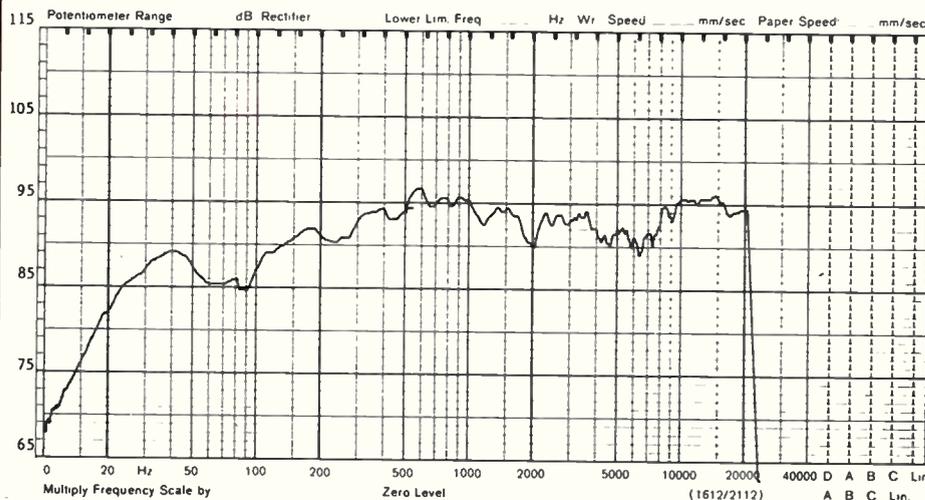
INPUT IMPEDANCE  
 ONE TEST:

100Hz/7kHz 4:1

100Hz	4.6	ohms
1kHz	4.8	ohms
6.3kHz	5.6	ohms
Min at 130kHz	4.0	ohms



Three frequency response traces showing the effect of the LF response plugs.



At top: frequency response, at centre, phase response and at bottom impedance. In all three cases, all controls are set to normal, and the measurement is made on-axis.

with a rounded end. The reason for this unusual shape was to increase the radiation efficiency of the driver and produce better spatial sound radiation uniformity at high frequencies. One unusual feature of the mid-range drivers is the sharp cut-

off on the low side of their pass band which Dali's research has shown is a positive attribute in producing overall improvements in sound radiation uniformity.

The construction of the mid range speaker diaphragm is rather unusual as it

utilises a new material called TPX for the diaphragm and a new flexible rubber surround material called Nonsorex.

The single 25 mm domed tweeter incorporates an extremely large magnet assembly with a cloth tweeter diaphragm which achieves extremely uniform radiation characteristics. Each of these speakers is individually tested and only the 'good ones' pass muster to be used in the Dali 40 speakers. Those that exhibit peaks and bumps in the response (and that's the majority) are rejected for use in the cheap speakers that Dali also manufactures. These carefully selected tweeters exhibit an extremely even and uniform sound radiation pattern over the frequency region 5 kHz to 25 kHz. This response is extremely flat up to 18 kHz with a small droop-over between 18-25 kHz which does not result in significant reduction in the audibility of the high frequency radiation.

At the rear of the cabinet the speaker uses a series of gold-plated terminals arranged in a bi-amp configuration for separately driving the woofers and the mid-range and tweeters. In addition to these four terminals there are six others which are intended to be used for bridging link interconnections. These additional terminals provide the capability of adjusting the tweeter by -1 dB, or the tweeter and the midrange by +1 dB. These miniscule adjustments seem to be far less desirable than more useful steps of +2 dB or +3 dB that I would have recommended and are a little illogical when carefully examined in terms of what the average person can detect.

Because of the loading ports at the rear and the normal recommended mounting positions, it is possible to substantially modify the low frequency response of the speakers together by their position in a room, and, separately by inserting supplementary foam plugs in either one or both of the rear venting ports of each of the two speakers.

### Measuring

I measured the frequency response of the Dali 40s, with no plugs installed, in my anechoic room. They displayed an unusually flat response extending from approximately 22 Hz to 20 kHz with a variation of less than +6 dB. I found that by inserting the supplementary foam plugs in the rear loading ports I could smooth the low frequency end response in approximately 2 dB steps by inserting one and then the other foam plug alternately.

The slight droop in low frequency response measured in the anechoic room between 20 Hz and 200 Hz is of course ef-

fectively compensated by ground plane or side wall reflections in a real listening room. As my subsequent testing confirmed the low frequency linearity in my standard listening room is remarkably flat and good.

The mid-range response in the 300 Hz to 5 kHz region is also extremely smooth and the tweeter performance between 5 kHz and 20 kHz exhibits a slight rise in response which the 1 dB adjustment capabilities did not really adequately cope with.

An examination of the frequency response in close proximity shows that the woofer with output response extends up to approximately 800 Hz and the mid-range provides significant output from below the cross-over frequency up to approximately 4.5 kHz. The tweeter response is remarkably flat from 5 kHz to 18 kHz and depending on the precise position of the microphone with relationship to that tweeter,

you are able to assess its direct radiation characteristics with great ease.

The impedance characteristics of the Dali 40 is so close to a genuine 4 ohm speaker characteristic, that this system can really extract optimum power from the majority of amplifiers. Although it exhibits reasonable efficiency, this is primarily because of the low flat impedance over the range 40 Hz to 20 kHz. The only speaker offering a better impedance linearity is the KEF 107 with its uniquely flat impedance characteristics.

The tone burst evaluations display reasonably smooth performance at midfrequencies, more than a trace of unusual jitter at low frequencies and significant carry-over and reflection characteristics at 6.3 kHz. As a result of these unusual characteristics I was particularly keen to evaluate the decay response spectra. These show a particularly smooth initial characteristic all the way across the fre-

quency response up to 25 kHz.

There is a modest but significant trace of a rolling natural frequency resonance in the tweeter at around 10 kHz but this is not a major defect and would most probably only occur in a limited number of speakers.

By contrast there is a significant reflection from the internal structure at about 400 microseconds after the onset of the decay's initiating pulse. I discussed this colouration with Peter Lyngdorf and he convinced me that this is due to the reaction of the closed coupled cavity behind the internal woofer. Based on the broad characteristic of the reflective pulse, it is possible that this is due to inadequate absorptive lining in the second driver's speaker diaphragm. Notwithstanding, the phenomenon is clearly there and the system would most probably be better off without it. Taken overall, however, the decay response spectra of the speaker are

## Research and Design

Three of the most important and published researchers on the acoustical theory of loudspeakers are Neville Thiele (previously with the ABC and Australian Broadcasting Control Board, Dr Richard Small (previously with the University of Sydney) and now at KEF in the United Kingdom and the Technical Director of KEF, Laurie Fincham.

It is intriguing to note that Dali has taken some of their work to develop an equally outstanding set of theoretical concepts. In 1979 Laurie Fincham published his work on the use of closed box coupled enclosures for a woofer which was then provided with a coupling port radiation element from the rear of the speaker. Although this offered an outstanding technical breakthrough, as our testing has shown on the KEF 107s, the resulting low frequency response is a little lumpy and not quite as flat as most purists would desire (see ETI December 1987).

Dali's research engineers wanted to incorporate a second order base reflect system into the Dali 40 speaker systems which would provide a band pass frequency response extending from below 40 Hz up to at least 1 kHz. This way they could utilise a conventional mid-range driver in a frequency region where its crossover would be compatible with the new theories that they had recently developed (and proven) for optimisation of sound quality over an extended listening arc ( $\pm 35^\circ$ ).

Their research led them into a simple yet exciting improvement in Fincham's concept. Instead of providing a closed cavity behind the driver with a single speaker, they incorporated a closed cavity driven by one speaker which was then connected into a sec-

ond vented enclosure tuned to a higher frequency to achieve an extended bass pass response. This system is a second order base reflect but once again instead of using only a single driver, they incorporated two separate drivers driven in phase opposition. This not only reduces the inter-action and unbalanced forces fed to the speaker enclosure but simultaneously provides the wherewithal to reduce the bottom-end resonance peak which is an integral feature of the Fincham second order base reflex system.

The height of the upper high pass vented section of the cabinet is adjusted accordingly to compensate for this loss of volume.

The most exciting advantage of the Dali system is its ability to provide a greatly expanded bandwidth covering almost a decade and a half, instead of an octave to one and a half octaves as displayed by the KEF. Dali describes this as the L-linkage circuit.

The other major advantage is a dramatic reduction in low frequency distortion and a significant reduction in cabinet resonance which plagues other speakers (irrespective of design detail).

The Dali design engineers did not stop here. The woofers that they developed incorporated significant improvements such as long voice coils in large-diameter magnet assemblies which provide extremely long travel, and, thus, have the potential to produce much higher acoustical outputs. With outputs as high as this, of course, the amount of air moved through the venting port is extremely high and the potential for regenerated or breathing noise is dramatically increased. Whilst KEF's approach to this problem was to provide suitable bell-mouthed entries and exits on its venting port, Dali overcame this problem by placing the port

at the rear of the cabinet where the directionality of the sound effectively masks or shields the problem.

This is a relatively elegant solution as the multi-cabinet construction and cancellation of induced forces on the speaker cabinet are basically equivalent to utilising a concrete cabinet which many other designs have to the same end.

In order to achieve the spatial directivity and improved angular spatial uniformity in the horizontal plane the Dali 40s incorporate two L-linkage circuits with two vented enclosures one above the other. By this means, the design achieves some of the primary attributes of a column loudspeaker without actually introducing three or more low frequency or mid frequency drivers.

Dali's research engineers wanted a material with the attributes of polypropylene in terms of lightweight performance and good loss factor, the attributes of titanium in terms of stiffness, but none of the liabilities which both of these materials exhibit. The material that they developed called TPX apparently has a density comparable with polypropylene (and is consequently very light), has a stiffness twice that of polypropylene and has a loss factor 10 times that of titanium and three times that of polypropylene.

Another problem which they had to solve was a simple method of reducing the ring radiation problems of vibrational modes being generated around the perimeter of the mid-range driver voice coil which are generally accentuated or materially assisted as a result of the spring-like characteristics of the conventional flexible surround. These problems can only be satisfactorily reduced by utilising a rubber with extremely high damping and "non rubber like" characteristics. Nonsorex provides just these capabilities.

still very good and confirm how far Dali has gone in developing an innovative speaker system.

The polar radiation characteristics of the Dali 40 are undoubtedly extremely good and confirm the merits of the basic design philosophy. The radiation characteristic of 1 kHz and 3 kHz is exemplary being only 3 dB down over approximately an 80° arc. At 6.3 kHz there is a trace of ripple in the response but the effective dispersion arc is still of the order of 110° which is extremely good.

At 10 kHz the dispersion angle starts to drop, as can be expected with only a single tweeter providing the dispersion capabilities. The arc response is still effectively only 3 dB down over a 60° arc. Taken overall, the radiation window in the horizontal plane of the speakers is extremely wide at approximately 110° +0 -3 dB. The radiation or dispersion angle in the vertical plane was much lower being ±15°.

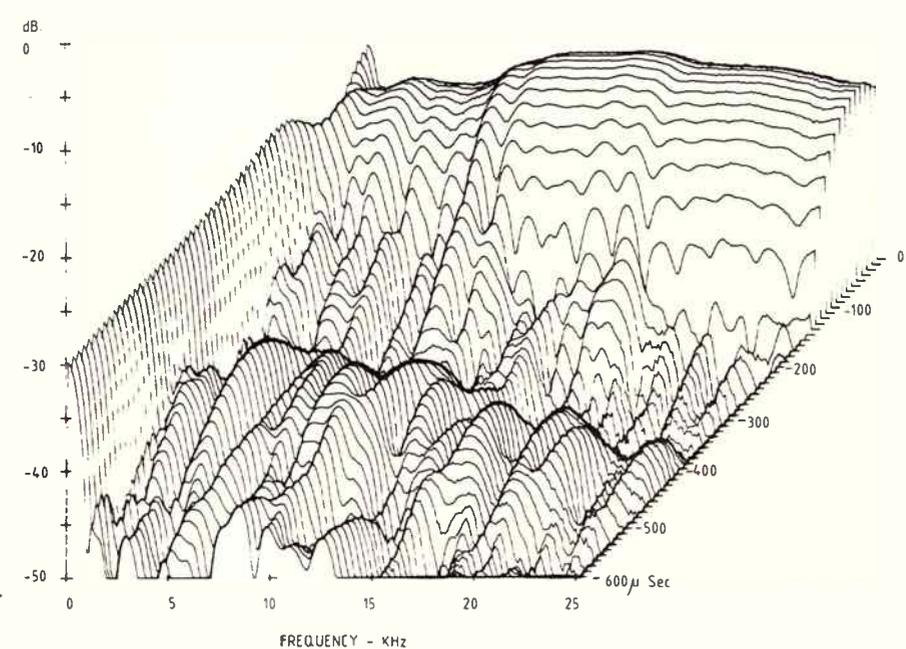
The measured sensitivity of the Dali 40s is moderately low as they require 18.5 watts to achieve 90 dB at 2 metres. By contrast the measured distortion characteristics are reasonably good, but not outstanding.

The measured distortion at 90 dB was 1.2% at 100 Hz, 0.18% at 1 kHz and 0.67% at 6.3 kHz (but with a reduced input and output signal).

### Subjective Assessment

I derived a lot of pleasure assessing the subjective characteristics of these speakers, as I had received a number of exciting and new discs from Polygram, Denon and Virgin Records.

The first of these was *An Evening of Strauss* with the London Symphony Orchestra conducted by John Georgiadis, IMP PCD 856. This starts with the



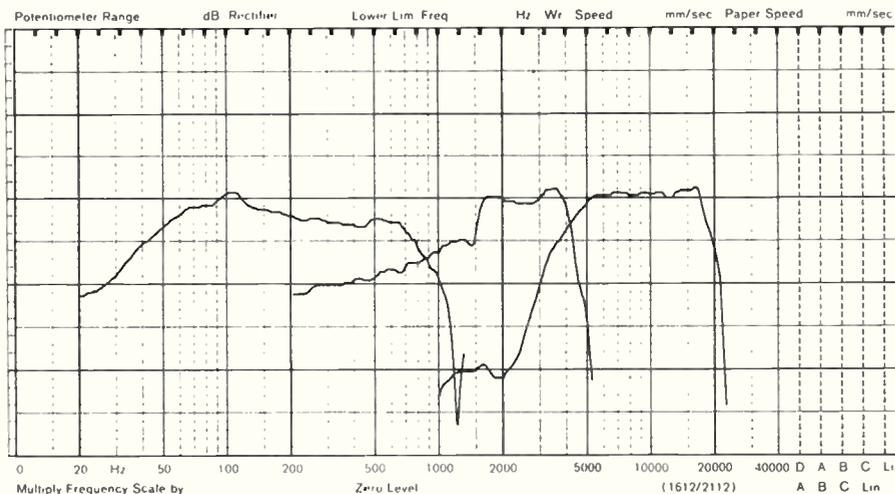
memorable "Champagne Polka" with those magnificent ear shattering pops that have the ability to destroy mundane speakers at high signal levels when the voice coils or speaker diaphragms separate from their baskets. Not so the Dali 40 which produced peak levels well in excess of 120 dB without any sign of distress.

I then progressed to a magnificent new rendition of Mussorgsky's *Pictures at an Exhibition* with Charles Dutoit and the Montreal Symphony Orchestra, Decca 417229-2. This provided superlative and spine tingling music which showed the Dali 40s to quite some advantage. This was followed by another wonderful disc conducted by Charles Dutoit and featuring Jorge Bolet with *Tchaikovsky's Piano*

*Concerto No. 1* and *Rachmaninov Piano Concerto No. 2*, Decca 421181-2. I could shut my eyes and imagine myself in the front row of the Opera House without any trouble (and as I did not have to go — far less trouble). Once again the Dali 40s really shone.

The last disc that I used was the Suk Trio in *Beethoven's Archduke Trio* Denon 33CO-1586 which is the best rendition I have yet heard of that piece. The violins and cellos were literally in the room with me and I most certainly did not have to go to the Opera House or the Seymour Centre to near the Musica Viva presentation. I shifted my emphasis to voice recordings and found that although I could detect the difference between the Dali 40s and my reference it was not really as pronounced as it is with most speakers. My last attack was to play pink noise and reassess the room response of the Dali 40s with and without supplementary porting plugs.

Although I have been critical of some aspects of the design philosophy and objective performance assessments of the Dali 40s, they are nonetheless one of the most outstanding speakers that I have had the pleasure to assess in the last year. The Dali 40s have technically eclipsed some of the advances made by the KEF 107s and as a consequence will be a worthy adversary for that excellent system. At a selling price of \$7990 per pair, there will be a more limited market than they deserve, but they are still the most outstanding speaker that Dali have produced and I venture one of the best, if not the best speaker currently manufactured in Denmark.



The effect of the crossover. The traces were made with the microphone 5 cm from the woofer, mid-range and tweeter to show the performance of individual drivers. Vertical scale is in dBs and horizontal in Hz.



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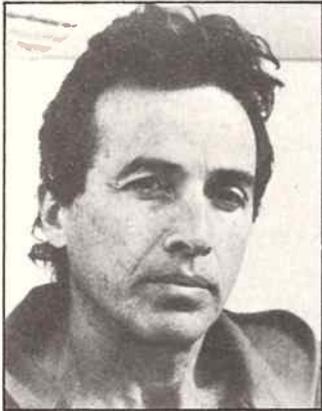
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# Reviews

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## Discs



**Title — Get Rhythm**  
**Artist — Ry Cooder**  
**Label — Warner Brothers**  
**Producer — Ry Cooder**  
**Cat No. 92-5639**

Ry Cooder is among the best known white bluesmen around. His following in Australia is not large but this is certainly no reflection on his talents as this, his latest album, proves.

*Get Rhythm* is one of Cooder's best releases to date. Every track is fascinating and is well worth a listen. The guitar work is up to Cooder's singular, brilliant standard and the lyrics are both humorous and bawdy. The most stimulating tracks are *Get Rhythm* and *Let's Have A Ball* with its exquisite refrain "Like I've never been balled before".

Brilliantly executed and packed full of bright refreshing tracks *Get Rhythm* is worth buying by anyone who likes their blues with a touch of spice.

Simon O'Brien

**Artist — Van Morrison**  
**Title — Poetic Champions Compose**  
**Producer — Van Morrison**  
**Label — Polygram**  
**Cat No — 832585/2**

Van the Man is back with a superb offering. Delicate, jazzy arrangements blend effortlessly with sublime lyrics and Morri-

son's lilting, plaintive vocals.

The better songs on this eleven-track CD are: "Queen of the Slipstream", a vintage Morrison-style tune with fine orchestration; "Sometimes I Feel Like A Motherless Child", a marvellous soft jazz version of this evergreen folk ballad; "Alan Watts Blues", a bouncy tune with crisp guitar playing and tight piano accompaniment and "Did Ye Get Healed", an infectious melodic tune, with some great sax playing and fine background vocals.

In recent years, he has been far from prolific, so a Van Morrison release is an event in itself. With *Poetic Champions Compose* he should gain a newer, younger audience as well as satisfy his legion of dedicated fans.

Recommended.

Mark Lewis



**Artist — Jimmy Barnes**  
**Title — Freight Train Heart**  
**Producers — Jonathon Cain, Mike Stone, Desmond Child, Mark Opitz**  
**Label — Mushroom**  
**Cat No — CD53238**

This Jimmy Barnes solo effort accurately encapsulates the tough, straight-ahead rock style for which he is renowned.

Although this offering has increased international input, with performances from Neil Schon, Huey Lewis, David Lindley to name a few, Barnes still retains the no-frills rock

formula that took his former band Cold Chisel and later himself to the top of the Australian charts.

The better tracks are: "Driving Wheels", a slower style rock song with tasteful slide guitar; "Seven Days", a blistering rock rendition of a minor Dylan classic, "Too Much Ain't Enough Love", a powerful rock ballad with terrific guitar and Barnes in fine vocal form; and "Last Frontier", another big production rock ballad with an Australian lyrical theme and excellent guitar playing.

With *Freight Train Heart* Barnes has finally shaken off the spectre of Cold Chisel and emerged as a solo rock artist of calibre and substance.

If your brand of rock is tight, loud and uninhibited then go for it; Jimmy's your man.

Recommended.

Mark Lewis

**Title — Debut**  
**Artist — Dave Loew**  
**Producer — Peter Casey and Dave Loew**  
**Label — Philips/Polygram**  
**Cat No — 832 677-2**

Dave Loew is an Australian cellist with an international reputation. According to his CV he has recorded various film scores including *The Empire Strikes Back*, *The 39 Steps* and numerous others. On this album Loew has assembled a number of talented musicians, including the National Arts Orchestra, and plays popular classical tunes from Vivaldi's *Winter* to Shostakovich's *Gadfly*.

It should be stressed that these reproductions are not 'updated' versions of the originals but remain genuine to the styles of the various composers. All of the tracks display Loew's mastery of his instrument but particularly satisfying are Prokofiev's "Russians" which comes over with an air of dark brooding menace and Marie-Joseph Canteloube's *Bailero* which Loew

infuses with just the right amount of rusticity.

*Debut* augurs well for Loew's future as a popular recording artist. If he can keep on producing work of this standard his future is assured.

Simon O'Brien

## Videos

**Title — Outrageous Fortune**  
**Distributor — Roadshow/Touchstone**  
**Length — 95 minutes**  
**Rating — M**  
**Standard — ★★★★★**

It is rare indeed that a second film lives up to its original predecessor, but such is the case with *Outrageous Fortune*. Everyone thought Bette Midler was marvellous in *Ruthless People* and surprisingly, she is even better in this offering. Here she is teamed with Shelly Long of *Cheers* fame as two ladies in love with the same man who, to tell the truth, is something of a rotter. Their adventure takes them half-way across the country, but the comedy remains taut throughout. Long and Midler are a perfect team, the laughs are constant, the wit is acidic and, if anything, Midler is even more assured than in her previous comedic effort. This comedy is highly recommended and, in these days of teenage offerings and vapid viewing, a crisply made comedy is a rare thing indeed. Perhaps the video of the month.

Peter Brown

**Title — Go West**  
**Distributor — CEL**  
**Length — 96 minutes**  
**Rating — G**  
**Standard — ★★★★★**

While not being the best of the Marx Brothers classics, this is certainly worth a glance. The purists in the audience might proclaim that the Paramount period marked the very acme of the Brothers' achievements, but, for my money, once Irving

★★★★ Don't miss it      ★★ Please miss it  
 ★★★ Value for money    ★ Watch the microwave instead

Thalberg and his minions got hold of the Brothers Three at MGM, then the magic really started to flow.

Of course, the very peak of perfection is marked in *Night at the Opera*, but this offering certainly finds the Brothers in top form. A welcome sight or perhaps non-sight is the absence of Zeppo, a romantic lead used by Paramount, but thankfully dispensed with by MGM. Highlights include a scene in the saloon and, of course, the hectic train ride at the very end of the movie. Fast paced and irreverent, there has never been a troupe quite like the Brothers Three. This reviewer is also thankful that a few more of the vintage offerings are now being brought out of the video format.

Peter Brown

**Sherlock Holmes And The Secret Weapon**  
 distributor — CEL  
 Length — 68 minutes  
 Rating — PG  
 Standard — ★★★

Baker Street Irregulars might be shocked at the sheer irreverence of this offering which transports the timeless detective to modern times, but at least it is a chance to see Basil Rathbone as Holmes. This was the second Universal offering in its Holmes series and the

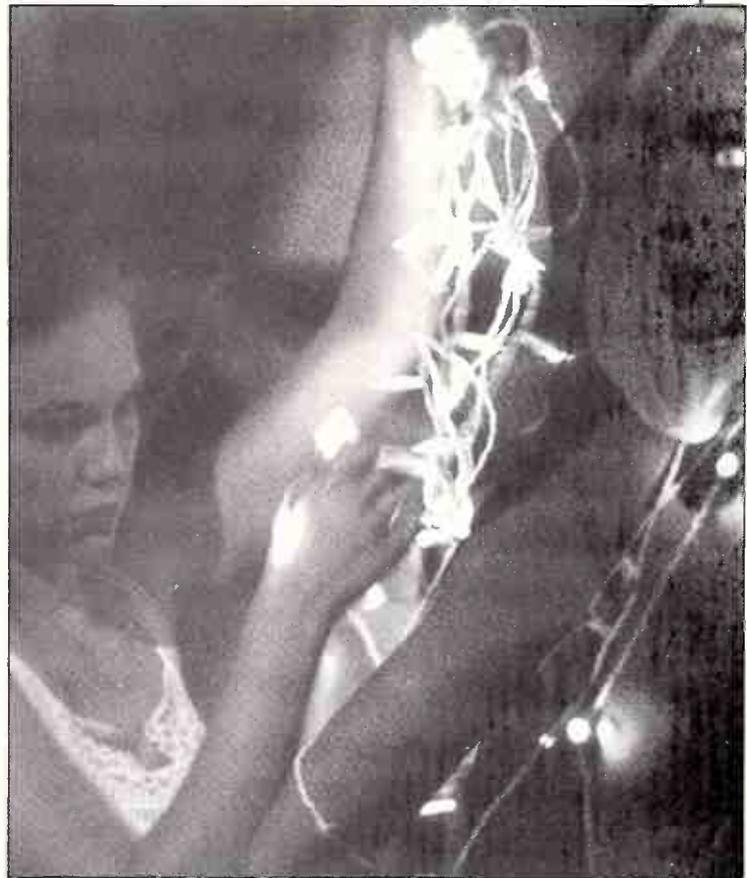
studio grabbed the opportunity to grind out a little war propaganda to the extent that Holmes quotes a little Shakespeare and Churchill at the end of the piece.

There is some of the original *The Dancing Men* in the story, but little else connected to the original Conan Doyle offering. However, Rathbone is superb as is Nigel Bruce as Dr Watson. Lionel Atwill makes a marvellously malevolent Moriarty and this film marked the first time Dennis Hoey was cast as the perpetually inept Les-trade. This film has been coloured by computer, but for my money, they shouldn't have messed with a masterpiece.

Peter Brown

**Title — Lady Beware**  
 Distributor —  
 Road show  
 Length — 103 minutes  
 Rating — R  
 Standard — ★★★

This is a genuinely shocking movie although I am the first to admit I have an appallingly low terror level. I have been known to run screaming from the room because of a particularly gruesome commercial. However, this tale of a window dresser being threatened remained taut and terrifying throughout.



Diane Lane, as the lady in question, is a passable enough actress, but the real terror comes from the story itself. She is subjected to a series of obscene telephone calls and she starts acting out her tension via the decorations in the shop window. Finally, it all gets too much for her and she reverses the tables on her caller. Well acted and filmed, this had me sitting on the edge of my seat and even though the more jaded members of the audience might find this offering a little passé, I thoroughly enjoyed it.

Peter Brown

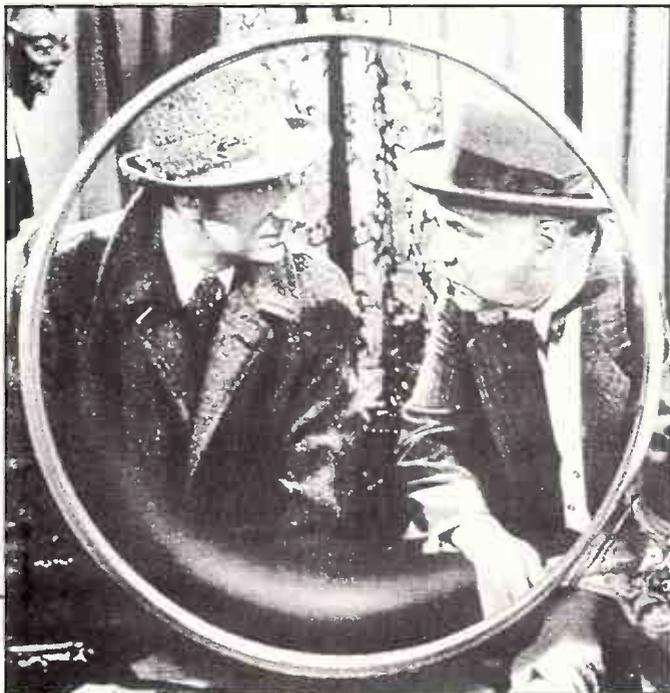
**Title — The Colour Of Money**  
 Distributor —  
 Touch stone  
 Length — 115 minutes  
 Rating — M  
 Standard — ★★

Disappointing is the sad verdict for this effort which tries so

vainly to capture some of the atmosphere of the original *The Hustler* which starred Paul Newman and Jackie Gleason. Here, Tom Cruise is the pool shark and Newman, returning to the character of Fast Eddie Felson, is the promoter. The biggest weakness is Cruise himself who emerges as a greasy know-it-all with little or nothing of Newman's original menace which graced the original production. Also, sadly, Gleason is missing and a film about pool without Minnesota Fats is akin to toast without Vegemite.

The camerawork is outstanding, but the end equation is that the absence of a riveting character will always kill a movie. Perhaps another salutary lesson is that there have been very few movies which can get away with being a sequel. A little more black and white graininess and a little less Tom Cruise and this effort could have been a winner.

Peter Brown





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With Yamaha's new AVC-30 Video Integrated Amplifier, you'll be watching videos with your ears. As much as you do with your eyes. Now that may sound strange. But with the AVC-30, that's the only thing that will sound strange. Because once you plug your video cassette recorder and speakers into the AVC-30, the room will be filled with incredibly lifelike sound. And when you plug in your graphic equaliser, compact disc player, stereo tuner and turntable, the AVC-30 becomes the control console of your own surround sound video centre. When you hear your next video you'll see exactly what we mean. The AVC-30 Video Integrated Amplifier. For just \$899.\* From Yamaha.



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READER INFO No. 23

\* Ret. retail price.

World Radio History

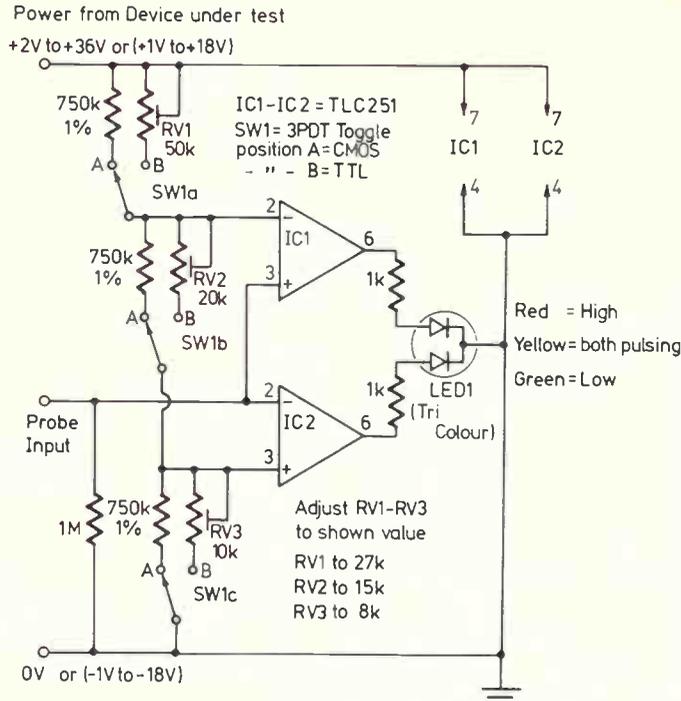


## Logic Probe

I.C. Logic Probes are needed when testing logic circuits in the absence of C.R.O., but some probes cost up to \$40. Not wanting to spend this much on one, this circuit was built.

IC 1 & 2 are TLC-251 Low-power CMOS Op-Amp I.C.'s and are configured as comparators. IC1's inverted input is held at  $\frac{1}{3}$  supply voltage in the CMOS position, or at 2.3V in the TTL position. IC2's non-inverted input is held at  $\frac{1}{3}$  supply voltage, or 0.8V (TTL, with 5V supply). With SW1 set to TTL and a 5V supply voltage, adjust the pots to the values as shown in the circuit diagram.

If the input is higher than  $\frac{2}{3}$  supply voltage (CMOS) or 2.3V (TTL), IC1 will go high, lighting the red LED. If the input is lower than  $\frac{1}{3}$  supply voltage (CMOS) or 0.8V (TTL) IC2 will go high, lighting the green LED. If the input voltage is switching fast



enough, between high and low states, the two LEDs will appear permanently lit, resulting in a yellow colour. Static voltages are not shown by LEDs, but are indicated by no LEDs

on. With no input but voltage applied to the circuit, the green LED will be on.

D. Oster  
Vista  
SA

## Idea of the Month

### Analogue To Digital Joystick Converter

I possess an analogue joystick, but all of my software needs a digital joystick. I decided to make a converter to make the analogue joystick appear to the computer to be a digital joystick. This saved the cost of a new joystick, and besides, the analogue ones are superior (in my view), as they really move a decent distance, whereas the digital ones only move a millimetre or so.

The heart of the circuit is an LM339 quad comparator which can run off a single supply of 5 V (provided by the computer). This is set up by two comparators for each potentiometer on the joystick. The output of one of them goes low (active) when the voltage determined by the potentiometer is above a threshold; the other goes low when the voltage goes below a different threshold. Trimpots determine

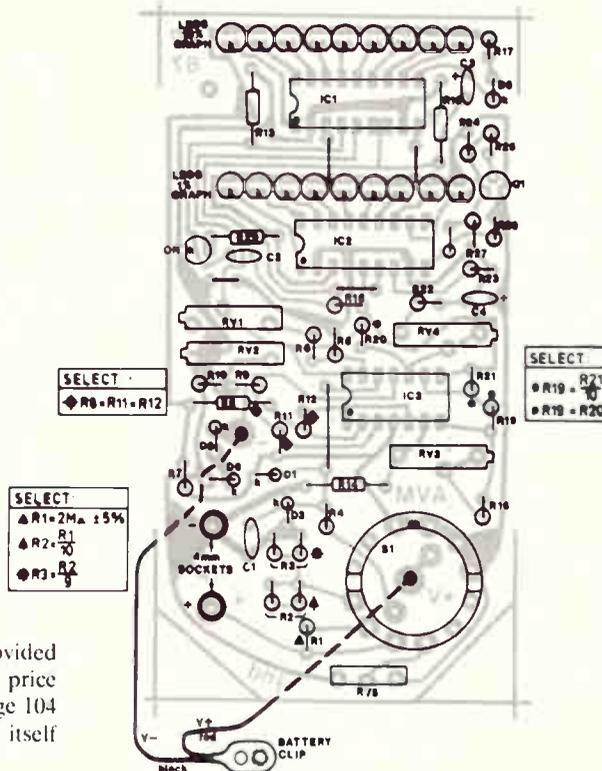
## Minimart

**FOR SALE: COMMODORE 64 SOFTWARE**, Educational games from \$2. Many titles. For free catalogue phone (049) 46 8553 or write to Peter Delahunty, 84 Dilker Avenue, Valentine, NSW 2280.

**FOR SALE: Completed 1616**, keyboard, power supply, manuals, etc. Fully socketed. Worth \$836 unassembled. Sell \$750. Phone (02) 639 8262 after 6 pm.

## Errata

The overlay for the ETI-180 is provided below. Note also that Kookaburra's price for the twin disk CT mentioned on page 104 of February ETI is \$1950 for the unit itself and \$600 for the hard disk.



## Letters to the Editor

### Dirty Needles

Very good ideas for my purposes as a student. (I am taking a one-year TAFE course with relevant background in pure mathematics. No trade experience for what is a trades course.) AIDS came from dirty needles, nothing else; 7000 dirty needles, it's a scandal.

Kaemmerer  
Port Pirie, SA

### Where Can I Get?

Could you please supply the name and the address of the Victorian distributor of smART-WORK and Hiwires software.

B. Brown  
Lalor, Vic

Entertainment Audio, 59 King William St, Kent Town, SA 5067 is the Australia-wide distributor. Phone (08) 363-0454.

continued page 68.

these two thresholds which are the same for each potentiometer (ie, the two high thresholds are the same, as are the two low thresholds). These trimpots should be adjusted for personal taste.

The potentiometers in the joystick were logarithmic, not linear, making conversion to a voltage tricky. If a 5 V potential difference were applied across the ends, the lower threshold voltage would be only about 0.2 V, so adjustment of the trimpot would be difficult and unstable (ie, bumps would effect it adversely). Also, as I wanted to use the existing cable (which only gives two of the three leads), I decided to use the arrangement shown which allows for threshold voltages of about 1.5 V and 3.5 V.

The trimpots' values were not critical, however they should be linear. The 4k7 resistors were

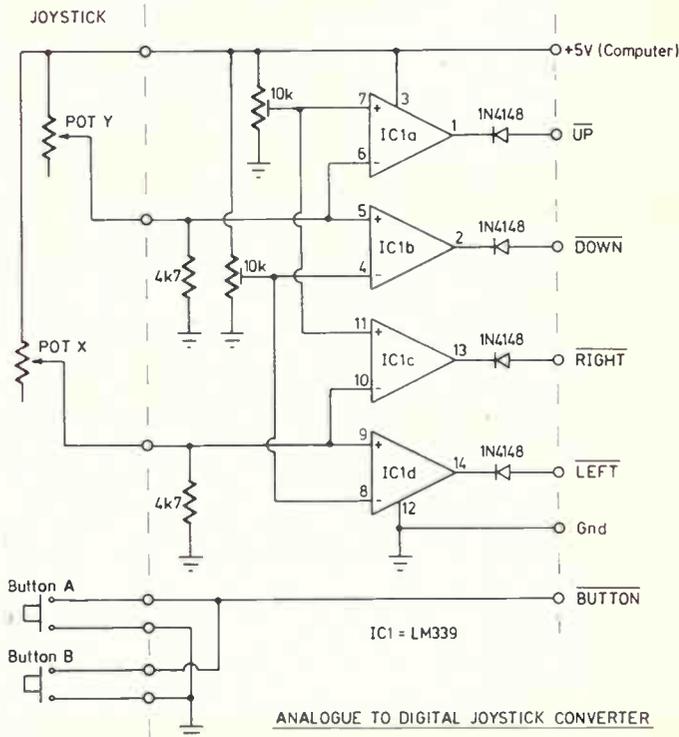
chosen as roughly equal to the "medium" resistance (ie, with joystick in the "neutral" position) between the two leads on the potentiometer.

The two switches button A and B are wired in parallel, as my computer can only handle one.

The IN4148 diodes made the circuit seem more like four switches rather than four logic levels. They are probably not necessary for most computers, but they add to the safety margin.

I constructed the circuit on a piece of veroboard, and then mounted it quickly and easily (and cheaply) inside a match-box. I could have mounted it inside the joystick box, but I wanted to keep the nice flexible cable it already had.

**A. Conway,  
Doncaster,  
Vic.**



Feed Forward needs your minds. If you have ideas for circuits that you would like to enter in our idea of the month contest, programs for the computing columns or just want a word with the editor, send your thoughts to:

Feed Forward  
ETI, Federal Publishing,  
PO Box 227,  
Waterloo, NSW 2017

Contributors can look forward to \$20 for each published idea/program which should be submitted with the declaration coupon below.

Programs MUST be in the form of a listing from a printer. You should indicate which computer the program is for. Letters should be typewritten or from a printer, preferably with lines double spaced. Circuits can be drawn roughly, because we have a draughtsman who redraws them anyway, but make sure they are clear enough for us to understand.

### 'Idea of the month' contest

Scope Laboratories, which manufactures and distributes soldering irons and accessory tools, is sponsoring this contest with a prize given away every month for the best item submitted for publication in the 'Ideas for Experimenters' column — one of the most consistently popular features in ETI Magazine. Each month, we will be giving away a Scope Soldering Station (model ETC60L) worth approximately \$191.

Selections will be made at the sole discretion of the editorial staff of ETI Magazine.



### RULES

The winning entry will be judged by the Editor of ETI Magazine, whose decision will be final. No correspondence can be entered into regarding the decision.

The winner will be advised by telegram. The name of the winner, together with the winning idea, will be published in the next possible issue of ETI Magazine.

Contestants must enter their names and addresses where indicated on each coupon. Photostats or clearly written copies will be accepted. You may send as many entries as you wish.

This contest is invalid in states where local laws prohibit entries. Entrants must sign the declaration on the coupon that they have read the above rules and agree to abide by their conditions.

### COUPON

Cut and send to: **Scope-ETI 'Idea of the Month' Contest/  
Computing Column, ETI Magazine, PO Box 227,  
Waterloo NSW 2017.**

"I agree to the above terms and grant *Electronics Today International* all rights to publish my idea/program in ETI Magazine or other publications produced by it. I declare that the attached idea/program is my own original material, that it has not previously been published and that its publication does not violate any other copyright."  
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Title of idea/program .....

Signature ..... Date .....

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## NEXT MONTH'S PROJECTS



### Project 290 Babyminder

*For looking after the bicentennial baby — a visual alarm that lets you in the lounge room know if the infant is bawling its heart out in the nursery.*

### Project 187 Protopac

*A deluxe 1988 breadboard with all you'd require including two supply rails, an oscillator and pulser.*

### Project 1611 VZ300 EPROM Programmer

*That says it all.*

## FEED FORWARD

### ETI for Kids

Great magazine. Heaps of interesting articles but why not make a kids page with their programs and circuits, etc? Keep up the good work.

J. P. Wallis  
Cleveland, Qld

### More Sound

Great magazine! Perhaps you could have more on sound equipment.

A. J. Nelson  
New Zealand

*ETI, the non-ageist magazine.*

### Remember the Oz Card

Thank God for the demise of the Australia Card. I have a gut feeling this is only the beginning of the onslaught into our privacy. Keep up the good work.

Ian Hanigan  
Matraville, NSW

### One for the Commodore

I think your magazine is the best electronics magazine. Could you do an article on C64 graphics.

Matthew Elliott  
Hobart, Tas

### Finding The Boards

I recently bought ETI for the first time and I enjoyed your D.I.Y. kits, but you do not mention where the kits are available.

I don't have the facilities to make printed circuits, nor do I want to start it for the occasional kit. Can you help? Who sells kits or makes printed circuits?

Ingolf Schmacke  
Pialba  
Qld.

### One for photography

My interest in photography led me into electronics, but I have found little in the way of kits or information in this field. Photography is almost dependent on electronics and its innovations, but magazines of your calibre have completely neglected the photographer/electronics hobbyist.

J. P. Black  
Dorofield Gardens  
S.A.

*See the January Yearbook issue of ETI for a list of kit and pcb suppliers.*



### Project 186 Part II of the AC Voltmeter

*Complete this cheap, useful measuring instrument.*

## NEW PRODUCTS

### Quest CAD

Quest International Computers has announced the release of what Quest states is the world's first Personal Photoplotter, for use with PC based Computer Aided Design (CAD) Systems.

The Personal Photoplotter, called the QED 300, is primarily for producing one-to-one Printed Circuit Board artworks, although it is equally suitable for producing front and back panel masters using graphics, logos etc. The system works by exposing highly accurate light sources onto a light sensitive film.

The QED 300 is the result of a long term development programme by Quest in order to address the need to transfer designs from the CAD System to the manufacturing process. This included a close working



relationship with the Department of Applied Physics at Royal Melbourne Institute of Melbourne.

Said David Brown, Managing Director of Quest "Over the past three years we have experienced a tremendous increase in the use of PCs in the design process, but up until now the interface to the manufacturing process has remained

largely unchanged." He went on to say "The post processing of designs into artwork is dominated by Service Bureaux due to the historically high cost of Photoplotters. Our aim is to make this process available to every engineer."

The QED 300 is capable of being used with most of the major CAD systems and can be driven by either Gerber or

Hewlett Packard HPGL formats.

As well as using Photopens the system is also capable of using standard ink, fibre of ball point pens for checkplots and schematic drawings.

The initial version will produce up to A3 size outputs with plot limits of 416 x 176mm, and there is an A2 version under development which will enable plots of up to 594 x 432mm.

Eight standard Photopen apertures are supplied with the system plus there is a library of software symbol apertures, covering most of the requirements for PCB design. In addition both custom Photopens and software apertures can be supplied on request.

READER INFO No. 107

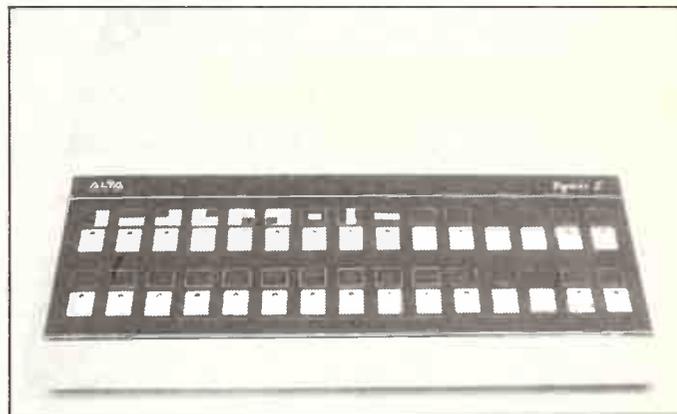
### Hewlett Packard 4954A Protocol Analyser

This instrument operates with several protocols including SNA, X.25, X.21 and DDCMP. The data transfer rate is up to 72 kbps with a data capture speed of up to 256 kbps. X.25 analysis provides packet decoding and display. In addition X.25 monitoring and simulation are possible with a variety of display formats. Internal mass storage is provided by a 3.5 inch micro-floppy disc drive and a 20 Mbyte hard disc. Additional storage is

possible using external drives via the HP-IB interface.

A number of filters are provided to reduce data capture requirements. The 4954A has several optional software packages for development applications in the various protocols. An X.25 network performance and package is also available. Outputs are available to a variety of peripherals including the HP 2225 thinkjet printer.

READER INFO No. 108



### Alta Pyxis-E

The Alta Group, have released a new TBC/Frame Synchroniser with wipes and digital effects. Named Pyxis-E the unit is a video production system that incorporates correction for A/B Roll editing systems with wipes, digital effects, transitions, modifiers, selectable transition rates with the ability to switch or fade audio with the video transition.

The most interesting feature of Pyxis-E is the ability to freeze in either field or frame single or both video channels. All effects including input

switching and freeze modes can be programmed into memory (up to 100 effects) then released either manually or via a trigger from the editing system.

Alta is represented in Australia and New Zealand by Mastatek. Full specifications and prices are available upon request. Contact Mastatek Pty Ltd, Suite 1, 245 Springvale Road, Glen Waverley, Vic. 3150.

READER INFO No. 109



## Safer Pools

Thousands of Australian swimming pools could be converted into virtual childproof safety zones, following the launch of an unique WA developed pool safety system.

The Doberman Pool Safety System is claimed to be the world's first system specifically designed to overcome false alarms. A problem which has until now rendered conventional alarms essentially ineffective.

The two-stage device firstly "senses" the presence of people near a swimming pool, and will then only sound the alarm when someone enters the pool. Co-developers, Mr Frank Kennedy and Mr Tony Webb said the system had been developed to protect children, particularly those in the six months to four years ago group.

The device works on the principle of movement detection, however, it is designed to sense only solid masses such as large



and small human bodies. A 20 GHz Microwave beam is emitted by the system which covers the swimming pool surrounds. The instant an adult or child enters the beam, the sys-

tem automatically self-arms.

In this state the alarm will only be activated when waves created by the entry of an adult or child, complete a low voltage circuit between two probes af-

fixed to the side of the pool.

Because of the two-stage design the device cannot be falsely triggered by objects such as chairs or pool toys being blown into the pool.

The system, for which international patents are now pending, must be manually switched off by owners before anyone can swim in the pool. Additionally, installation can only be made by specially trained personnel, which say the designers, overcomes the danger of owners incorrectly installing the system.

The Doberman Pool Safety System operates off mains power, however, it incorporates its own internal power facility in the event of a power failure.

First deliveries of the system, which are expected to sell for about \$750 each (fully installed), are expected to begin soon in Perth.

READER INFO No. 101

## Archimedes



What are claimed to be the world's most powerful personal computers were officially unveiled at Latrobe University recently by Australia's fastest man, Aerospace Technologies Chief Test Pilot, Ron Haack.

The Archimedes computers, designed by British company Acorn, incorporate a newly designed RISC computer processor chip. The chip enables the computers to carry out four million instructions in a second.

The Archimedes range (which

begins in price from around \$3000) brings the power of many mainframe computers into the realm of the home user. "Archimedes is the most significant advancement in computing since the release of the Sirius 16-bit desktop computer nearly four years ago," claimed managing director, Mr Julian Barson. "Archimedes not only provides a 10-fold increase in raw computing power, but a similar improvement in the user's ability to harness this power into useful functions."

The Acorn Archimedes is a 32-bit computer based around a Reduced Instruction Set Computer (RISC) chip set, which more than halves the number of components in the computer.

"That Archimedes is based around a philosophy of both growth and compatibility with other computer types," Mr Barson said. "Each machine can be upgraded to run in Econet networks, and have extra memory — up to 4Mbytes of RAM — and storage added.

A range of podules are avail-

able enabling Archimedes to emulate MS/DOS and alter operating systems. There is also a Musical Instrument Digital Interface (MIDI). The computers all have two channel stereo with seven stereo positions and eight voices as standard."

Among the key features for the harnessing of the Archimedes power is the different approach taken in including operational functionality on Read Only Memory (ROM inside the system).

In fact Archimedes has as much ROM as many computers have Random Access Memory (RAM), 512 kilobytes. In this is stored the operating system, the disk operating system, BBC Basic V language, Font Manager — including Greek characters, Desktop Manager and Window Manager, so that they are directly accessible to the computer, without the need for the user to 'load' them in from disk each time they are required.

The sophistication of the Archimedes also relies heavily on

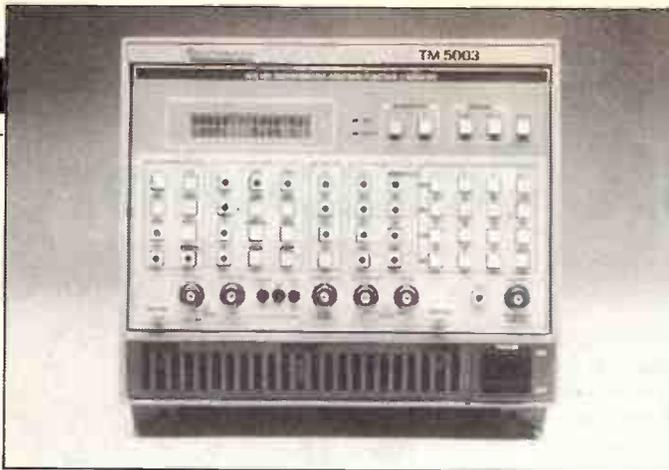
three specially designed peripheral chips. The first of these, the Input/Output (I/O) controller, controls system interrupts and the system bus.

The video controller (VIDC) handles the screen and absorbs many of the functions that consume the power of other computers. It offers 21 different screen display modes to suit the user of his software and handle displays from monochrome up to 256 colours, chosen from a total of 4096 color palette.

The Memory Controller chip (MEMC) has the ability to address up to 64 Megabytes of memory, and is programmable. Each system comes with a BBC and IBM compatible keyboard, and a three button mouse. The Archimedes 305 has 512 K-bytes of RAM, and the A310 with 1 Mbyte. The A410 has 1 Mbyte of RAM and the A440 has 4 M-bytes of RAM.

For further information contact: Mr David Wassell Barson Computers, 335 Johnson Street, Abbotsford, Vic 3067. Phone (03) 419-3033.

READER INFO No. 102



## Programmable Arbitrary/ Function Generator

An arbitrary/function generator capable of simulating any signal is being introduced by Tektronix for use in electronics design, research and development, mechanical engineering, test and measurement and materials testing.

Tektronix' AFG 5101 Arbitrary/Function Generator combines the functions of an arbitrary waveform generator with those of an analogue function generator.

As an analogue function generator, the AFG 5101 will generate standard sine, square, and

triangle waveforms, as well as DC, with frequencies from .012 Hz to 12 MHz (.2 percent accuracy from 120 Hz to 12 MHz) and amplitudes of 10 mV to 9.99 V peak to peak into 50 ohms. For greater frequency, accuracy (.005 percent), and stability, a synthesizer option is available (option 02).

Waveforms can be continuous, triggered, gated or burst. Triggering can be selected from internal, external, manual or GPIB modes. The AFG 5101 also provides for amplitude or frequency modulation of gener-

ated waveforms. Operators can increment or decrement DC, frequency, amplitude, offset, rate and burst number in preselected amounts to provide staircasing and other effects with the AFG 5101.

**Arbitrary Waveform Generation** — Using the AFG 5101's two independent, selectable 12-bit by 8K waveform memories, any imaginable waveform can be created. The 8192 horizontal addresses and 4096 vertical addresses combine in an array of over 33 million points for building signals. This includes waveforms that can be manually entered from front panel programming keys, or transferred to the AFG 5101 from computer data which has been generated via discrete inputs, mathematical equations, graphic programs, or by digitizers.

In addition to the point-by-point waveform generation, the user can select one of five predefined, 1000 point waveforms, including sine, square, triangle, ramp-up and ramp-down. These predefined waveforms can be placed and edited at user-specified locations in arbitrary

memory. The AFG 5101 features an internal 10 MHz clock for selecting a point-by-point digital-to-analogue conversion rate between 100 nanoseconds and 999.9 seconds for waveform frequencies of 1 uHz to 5 MHz.

The AFG 5101 can be used in R&D applications to drive sensors, timers and other laboratory equipment. In electronic and test tasks, arbitrary waveforms can simulate synchronization and servomechanism drive waveforms. For materials testing, arbitrary waveforms can be used to simulate metal stress and fatigue conditions. Waveforms simulating vibration characteristics can be used in mechanical engineering applications.

Sensitive measurement instrumentation for biomedical applications can be calibrated with the AFG 5101 using stored waveforms.

For further information contact your local Tektronix office. Sydney (02) 888-7066. Melbourne (03) 836-3355. Adelaide (08) 223-2811. Brisbane (07) 394-1155. Canberra (062) 51-6111. Perth (09) 325-8433.

READER INFO No. 103

## New Oscilloscope

Tektronix is introducing a 300 MHz digital oscilloscope with automatic setup and measurement capabilities, 100 MS/dual channel acquisition, 2 ns glitch capture, full programmability and 8-bit vertical resolution. And in a continuing commitment to make its high-performance technology the industry's best measurement value, Tektronix is also announcing a price reduction on its 2430A Digital Oscilloscope.

The new portable Tektronix 2432 Digital Oscilloscope combines high bandwidth with proven labour-saving features that automate and simplify measurements. The 2432 offers several industry-standard digital oscilloscope automation features that Tektronix established in earlier 2430 series products.

Using AutoStep, designers can build and run test programs on the 2432 — with or without a controller. Users select menu items, push buttons and turn knobs to build test sequences that can be stored in the scope's memory. In addition to setting up front panels, test sequences can include wait, print, self-calibration, self-test and repeat commands.

AutoStep saves time in repetitive test applications such as troubleshooting complex cir-

cuits or evaluating prototypes.

Even unknown signals can be captured and displayed on the 2432 with the push of one button using Auto Setup. This feature automates and simplifies setups for measurements such as rising edge, falling edge, pulse width and period.

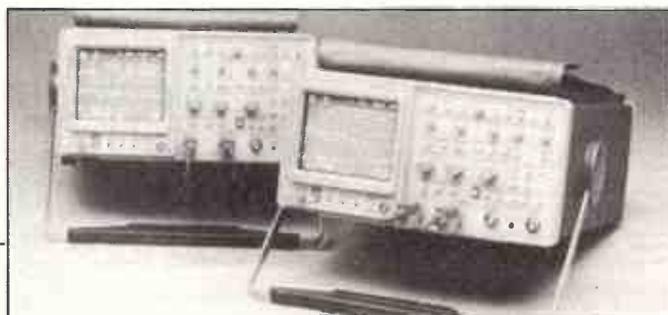
Up to 21 automatic measurements including amplitude, frequency, risetime, falltime, pulse width and propagation delay can be made simultaneously with Waveform Pa-

rameter Extraction. In a single "snapshot", the scope displays measurement readouts on up to 20 single-channel parameters. The scope continuously updates readouts on up to four parameters at one time.

This eliminates the need to move cursors and count gratitudes. Measurements are faster, more accurate and more repeatable.

The 2432's Save on Delta feature provides built-in pass/fail decision making for unattended testing. Known good waveform templates can be generated or downloaded into the scope allowing for pass/fail comparison against live waveform data. A direct printer/plotter output provides automatic documentation.

READER INFO No. 104



Win a fantastic

# Microbee 128K Computer

Worth over \$2,200

The Microbee 128K Premium computer is the electronics persons answer to their home computer problems. Included in the package is: Keyboard, twin 3.5 inch floppy discs, RGB colour monitor with tilt stand, EPSON LX800 printer with cable and Microbee's Auto dial modem. Also, software such as the Wordstar Professional Pack provides the flexibility of use for business or pleasure.

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AND automatically enter the  
draw for the Microbee Computer

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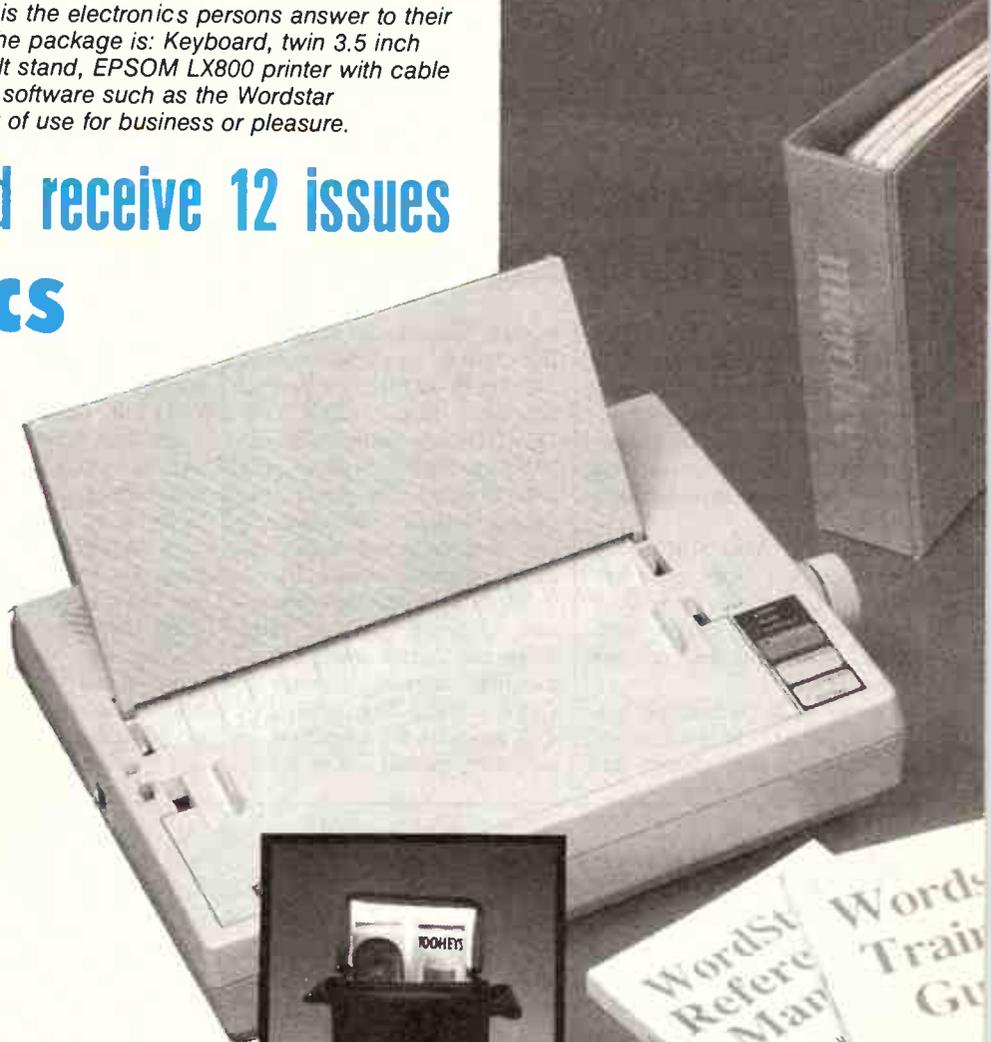
This portable blue cooler bag.  
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#### CONDITIONS OF ENTRY

- 1 The competition is open only to Australian Residents authorising a new/renewal subscription to Electronics Today International before last mail March 31, 1988. Entries received after closing date will not be included. Employees of the Federal Publishing Company, and Supply and Trading Pty Ltd and their families are not eligible to enter. To be valid for drawing, subscription must be signed against a nominated valid credit card, or, if paid by cheque, cleared for payment.
- 2 South Australian residents need not purchase a subscription to enter, but may enter only once by submitting their name, address, and a hand-draw facsimile of the subscription coupon to The Federal Publishing Company, PO Box 227, Waterloo, NSW 2017.
- 3 Prizes are not transferable or exchangeable and may not be converted to cash.
- 4 The judges decision is final and no correspondence will be entered into.
- 5 Description of the competition and instructions on how to enter form a part of the competition conditions.
- 6 The competition commences on January 1, 1988 and closes with last mail on March 31, 1988. The draw will take place in Sydney on April 4, 1988 and the winner will be notified by telephone and letter. The winner will also be announced in The Australian on April 6, 1988, and a later issue of Electronics Today International.
- 7 The prize is: a Microbee 128K Premium Computer with Keyboard and twin 3.5 inch floppy discs, RGB colour monitor with tilt stand, Epson LX800 Printer with cable and auto dial modem. Software includes the Wordstar Professional Pack valued \$2,274.
- 8 The promoter is The Federal Publishing Company, 180 Bourke Road, Alexandria, NSW 2015. Permit No. TC-87-3251 issued under the Lotteries and Art Unions Act 1901. ACT Permit No. TP 87/950 issued under the Lotteries Ordinance, 1964; Raffles and Bingo Permits Board Permit No. 87/2077 issued on 10/11/87.



But HURRY —  
The draw closes  
31st March, 1988!



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# SHOCK DETECTING ALARM MODULE

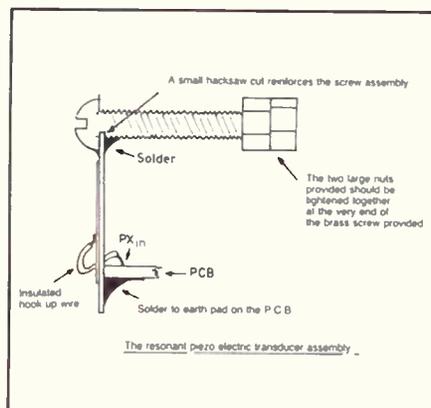
Install this unit into your vehicle and every time it is gently knocked it will flash its blinkers and pulse its horn two times. If however your vehicle is knocked pretty hard it will flash the car's blinkers and pulse its horn for the full alarm period. It's probably the closest you'll come to having "An untouchable vehicle". The unit is self contained, inexpensive, can be used with existing alarm systems and has many more features.

## BRANCO JUSTIC



THE MORE EXPENSIVE commercial alarms includes some type of relatively insensitive 'shock detector'. The unit described here goes one better! It features "two level shock detection". Its more sensitive level can be triggered by gently knocking the vehicle and only produces a short alarm period whilst its less sensitive level can be triggered by a hard knock to produce the full alarm period.

The hard knock trigger feature is commercially termed a "Shock detector" or a "Tow-away detector". As the terms imply these alarm have detectors that respond when somebody smashes into the vehicle



or tries to tow it away. This type of detector obviously trigger the full alarm period.

It is also worthwhile noting that with this alarm fitted there is no way you could knock the "Glass" around the vehicle let alone "Break it"! It would therefore be an understatement to say that this alarm features "Glass breakage detection".

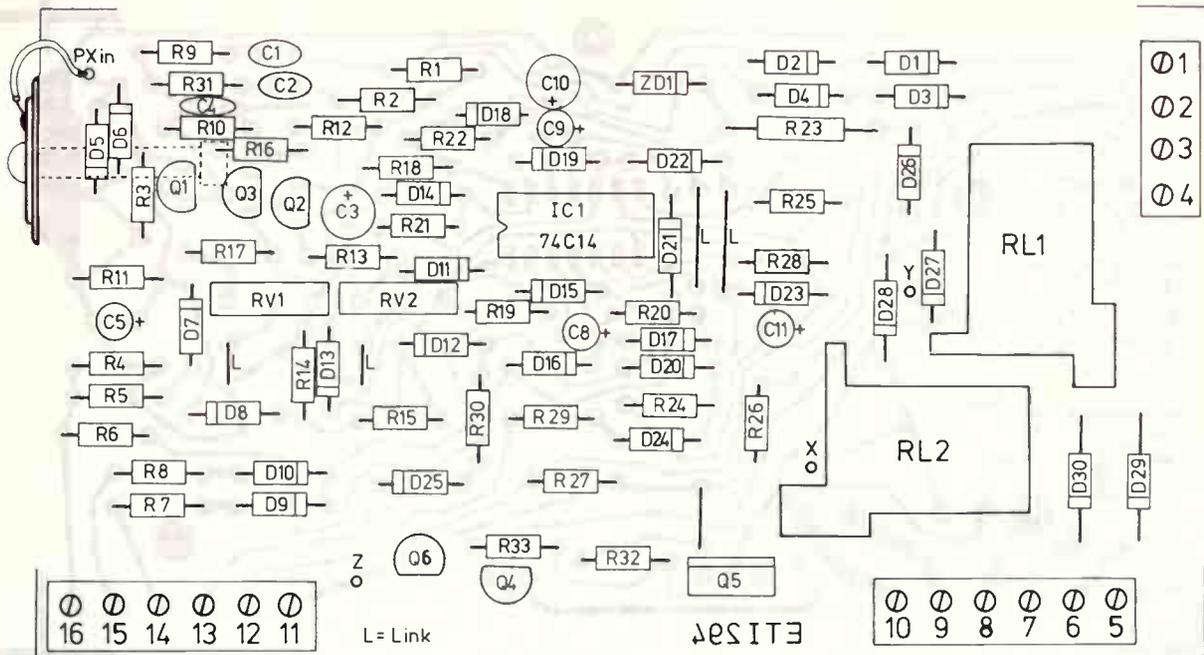
### Vibration Detector

The alarm described in this project is capable of detecting external interference to your vehicle prior to the actual "Break in" occurring. It does this by detecting high rate mechanical vibration or more specifically, "Knocking" of the vehicle. If the unit responds to low frequency vibration many false triggers would occur due mainly to wind and near movement of other vehicles, especially big trucks.

As already mentioned gently knocking a vehicle with this alarm fitted will produce a short alarm period. This period is actually about two seconds and during this time the car blinkers will flash twice and the car horn will sound twice. However, if the initial "Knock" is very hard, the unit will flash the car's blinkers and pulse its horn for the full alarm period which is about 2 minutes. Alternative wiring can also allow an external siren to sound continuously for the mentioned periods.

### Versatile Module With Many Features:

When used as a self-standing alarm this unit responds instantly. In simple installations a hidden switch can be used to acti-



vate it. Some type of remote controlled key would provide a more exotic method of switching it ON and OFF. The combination shown in the accompanying photograph employs a UHF remote controlled key which is available from *Oatley Electronics*.

Apart from the two level shock detector the alarm also has provision for being activated by existing door activated light switches, bonnet and boot switches and

additional external detectors. Provision is also made for activating the blinker flashing and horn pulsing function from an existing external alarm. Also the high level vibration detector (shock detector) can be used to activate an external alarm and thus provide this extra feature into an existing system. This however doesn't stop you using the low level vibration detector function by simply connecting up your horn and blinkers to this module. Also it is important to note that the alarm will re-trigger when the short or long alarm times have expired.

### Connecting Up The Alarm Module:

Because of the versatility of the unit we have referred to it as being an "Alarm module". To simplify its understanding and installation, all the input and output terminations on the circuit diagram are numbered (1-16) and these correspond to the terminal numbers shown on the component overlay. The number of terminals that are used depends on the user and the unused terminals are simply left open circuit. Here we list all the terminals in their numerical order and describe their functions:

1. This is the negative supply terminal; connect to the vehicles earth (Body) or it's negative battery terminal.
- 2 & 3. These terminals can be connected

to the active side of the vehicle door switch or to the bonnet and boot switches which are normally open circuit. They trigger the alarm when connected to ground and with normal sensitivity settings will initiate the full alarm period.

4. The positive 12V supply terminal. This terminal is connected to a +12V car battery. A 1A fuse should be included in this lead.

5. This terminal should be connected via a separate wire to a +12V fused supply; Existing blinkers fuse, etc.

6 + 7. These terminals are connected via separate wires to the left and right blinkers.

8 + 9. These terminals can be connected to the existing horn switch. They can alternatively be used to switch power to an external siren. Linking PCB terminals X-Y (see circuit diagram) will result in pulsed operation (during alarm time) of the load which is connected to terminals 8 + 9. Linking PCB terminals X-Z will result in continuous operation (during alarm time) of the load which is connected between terminals 8 + 9.

10. Not normally used.

11. A +12V supply is available at this terminal during alarm time. The load current should however be limited to 200mA. For example a "Piezo siren" could be connected between this terminal and ground.

The parts for this project are available from:

*Oatley Electronics*  
5 Lansdowne Parade  
Oatley West, NSW 2223  
Phone: (02) 579-4985  
Postal Address (Mail Orders):  
PO Box 89  
Oatley, NSW 2223

Prices:

Complete PCB plus

Components kit:

Terminal blocks and IC socket are included (as per prototype) ..... \$32.95  
150 x 90 x 50mm Plastic box:

As used in illustration ..... \$3.80

Post and pack ..... \$3.00

Note: The printed circuit artwork copyright for this project is owned by *Oatley Electronics*.

in which case it would sound during the alarm times.

**12.** This input is used in conjunction with an external alarm. Applying +12V to this terminal enables the blinker to flash and the horn to sound directly. The use of this input overrides all the other module inputs.

**NOTE 1:** When this input is used, the long alarm time constant employed in the module should be shortened to several seconds. Reduce the value of R20 from 10-Mohm to 220kOhm.

**13.** This output is used in conjunction with an external alarm. It is used to trigger an

external alarm. This simply adds "Shock detection" capability to an external alarm. The voltage at this terminal is normally 0V but rises to near full supply voltage during alarm time. If this terminal is used **NOTE 1** applies.

**14 + 15.** Applying supply voltage to either of these terminals will trigger the module for the full alarm period. These terminals can be used to trigger the alarm from external detectors, switches, etc. The most common application for one of these terminals would be the addition of an "Ultrasonic Movement Detector".

**16.** This terminal is used for switching the alarm "On" and "Off". Connecting supply voltage to this terminal will switch the alarm off whilst leaving it open circuited or grounded will switch the alarm on. Yes power is applied to the module at all times but don't worry. It consumes less than 150 microamperes when it is Off or On (Un-triggered).

### Construction, Testing And Installation

A complete kit of parts for this project is available from Oatley Electronics. Start construction by assembling all the components on the pc board. Watch the orientation of the electrolytic capacitors, diodes, transistors and the integrated circuit.

After double checking the location of all components adjust RV1 mechanical centre (Medium sensitivity) and RV2 to its maximum anticlockwise position (Minimum sensitivity); as viewed from the end closest to the terminal strip. Solder a wire link from terminals X and Y on the board. Apply a 12Vdc supply to the module; Positive to terminal 4 and negative to terminal 1. Gently tapping the board should

produce the short alarm and make both relays pulse twice simultaneously. Now rotate RV2 clockwise (increases sensitivity) until a harder tap on the board pulses both the relays. Connect terminal 16 to the +12V supply to reset the unit when desired. Allow about 4 seconds after each reset for the unit to reach its full sensitivity. Now check all the other terminal functions as listed previously.

Finally, the module should be securely screwed into the chosen box which in turn should be firmly secured into your vehicle. The best locations for the alarm would depend somewhat on the individual vehicle. Experimentation with the prototype showed that best results were obtained with the alarm mounted on large thin resonant panels such as wheel arches, panel at rear of motor compartment, etc. Generally, locations which produce the least sensitivity are also places of least movement in a vehicle; Positions which are closest to the centre of the vehicle and positions which are very close to the shock absorbers! As a general rule, mount the alarm as high as possible, as far away as possible from the centre of the vehicle on a large thin panel which is away from the shock absorber.

When setting the final sensitivity (after installation), use the previously described procedure which is summarised here; with RV2 set for minimum sensitivity, adjust RV1 until gentle knocks trigger the short alarm time than adjust RV2 until hard knocks trigger the long alarm times. Wait 4 seconds between tests and short terminal 16 to supply if you want to reset the circuit. Use gentle full fistful knocks to set the high sensitivity and slam your doors to set the high sensitivity.

### ETI-294 PARTS LIST

**Resistors**.....All 1/4 W 5% tolerance unless stated otherwise

R1, R2, R27, R32 ..47K  
 R3, R14, R19, R21,  
 R25.....1M  
 R4, R7, R8, R9,  
 R11, R24, R31.....100k  
 R5, R6, R18, R33 ..1k  
 R10.....S.O.T.  
 R12, R16.....47OR  
 R13, R17, R28,  
 R30.....4k7  
 R15.....2k7  
 R20.....10M (S.O.T.)  
 R22.....220k  
 R23.....10R 1W, 10%  
 R26, R29.....10k  
 RV1, RV2.....100k Trimpots

#### Capacitors

C1, C2.....100n Monolythics  
 C3, C10.....100µ 16V Electrolytic  
 C4.....4n7 Greencap  
 C5, C8, C9.....10µ 16V Low Leakage Electrolytic  
 C11.....1µ 16V Low Leakage Electrolytic

Note C6, C7 are omitted

#### Semiconductors

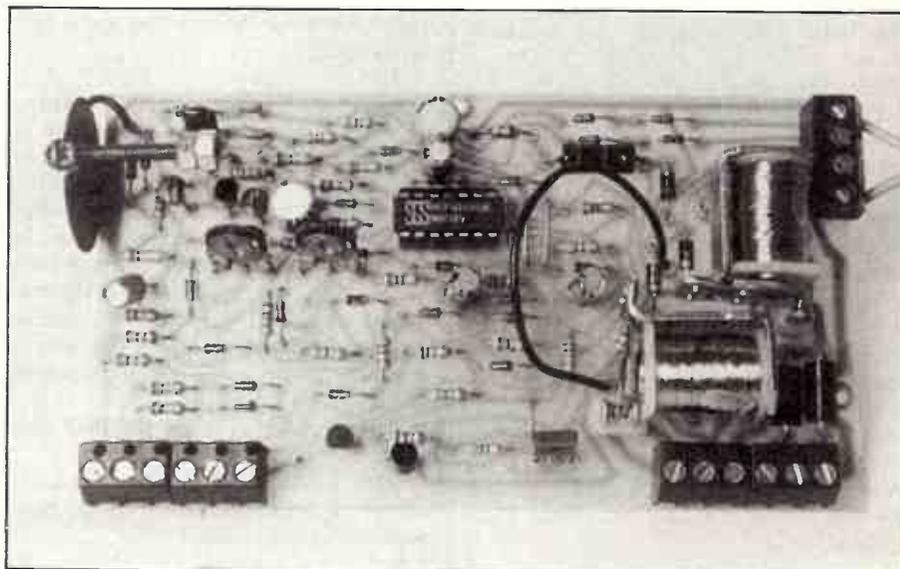
IC1.....74C14 Hex Schmitt Inverters  
 Q1.....2N5484 N channel FET (S.O.T)  
 Q2, Q3, Q4.....BC559  
 Q5.....BD140  
 Q6.....BC327  
 D1 to D25.....4148  
 D26, D27, D28.....1N4004  
 D29, D30.....5404  
 ZD1.....15V 1W Zener

#### Miscellaneous

PX1.....Piezoelectric Transducer

PC board, 1 x 14 pin IC socket, 1 x 4 way PCB Terminal Block, 2 x 6 way PCB Terminal Block, 2 x Relays, 1 x Plastic box, screws, nuts and 100mm of hook up wire.

Note S.O.T components will be supplied with the kit.



**HOW IT WORKS:**

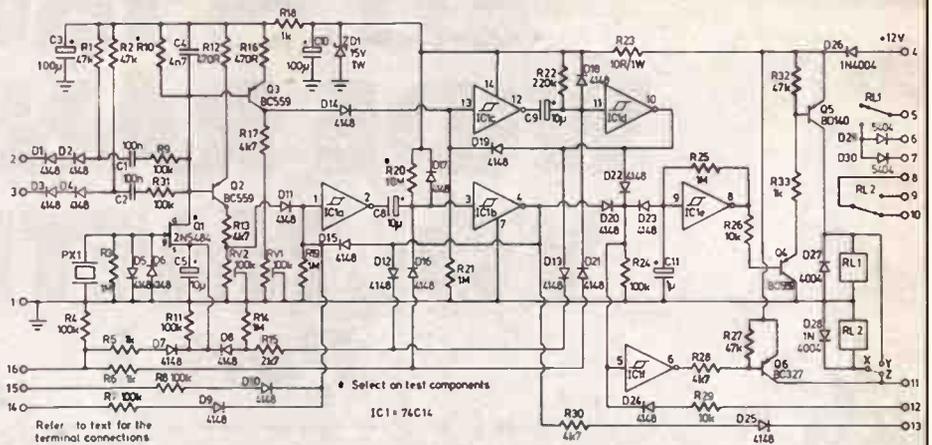
A Piezoelectric disc produces an output voltage which is proportional to the amount of the mechanical displacement (bending). The disc employed in this project is made to resonate at about 70Hz by the screw and nut assembly which is attached to it. The output voltage derived from this resonant pick up assembly is applied to two back to back diodes which limit the voltage applied to the following FET amplifier to about 800mV P-P.

The FET employed in the amplifier stage associated with Q1 is biased near it's cut off voltage because of the high value of source resistor (100K). Because of the high spread of FET characteristics the FET employed in this project is supplied with a suitable value of drain resistor, in the kits supplied by Oatley Electronics.

Transistors Q2 and Q3 are biased below cut off and form two identical amplifier stages. The gains of these two amplifiers are adjusted by varying the amount of collector resistance (RV1-RV2). The setting of RV1 and RV2 thus determines the sensitivity for the high and low trigger levels respectively. Because the transistors Q2 and Q3 are cut off their quiescent collector voltages are 0V but this voltage can rise to near full supply voltage if an input signal is applied, i.e: when the resonant piezoelectric assembly is vibrated. When the collector voltage of Q2 and Q3 exceeds the threshold voltage of the following gates (IC1a and IC1c) the two monostables associated with them will be triggered.

Gates IC1c and IC1d and components C9, D18, R22, D19 and R21 make up a monostable which determines the short alarm time. This time is determined by the values of resistor R22 and capacitor C9 and with the values shown it is about 2 seconds. Diode D19 keeps this monostable in its unstable state after triggering whilst diode D14 isolates the preceding amplifier stage (Q3). Diode D18 prevents the gate voltage of IC1d exceeding the supply voltage when the monostable reverts to its stable state. An almost identical monostable circuit made up from gates IC1a and IC1b is used for the required long alarm time. However, its time constant is increased to about 2 minutes by employing a 10Mohm resistor (R20).

The outputs of both the monostables are coupled together via isolating diodes D22 and D20 to R24. This point is also connected directly to the inverter (IC1f). When either of the monostables are triggered the input to IC1f will be a logic level "1" and the inverter will produce a "0" output and



turn on transistor Q6 via resistor R28. Transistor Q6 will in turn supply nearly full supply voltage at terminal 11 and if the link from X to Z is connected relay RL2 will be activated.

The Schmitt inverter IC1e with R25 and C11 forms an oscillator which oscillates at approximately 1Hz. The oscillator is prevented from oscillating when the unearthed end of R24 is at a low potential because of the loading effect produced by R24 via the forward biased diode D23. However, as already mentioned, during alarm time the unearthed end of R24 is at a high potential and therefore D23 is reverse biased which enables the oscillator. The oscillator output switches the relay RL1 via switching transistors Q4 and Q5. The contacts on RL1 are used to switch the cars blinkers via isolating diodes D29 and D30. If the link between terminals X and Y is connected, RL2 will also be pulsed during alarm time. Diodes D27 and D28 prevent high back E.M.F. voltages from occurring across the relays and therefore protect their driving transistor/s.

If the input terminal 2 is momentarily earthed capacitor C1 would quickly charge via R10, R9 and the forward biased diodes D1 and D2. The charging current produces extra voltage drop across R10 thus dropping the FETs (Q1) drain voltage and switching on transistors Q1 and Q2 which triggers the full alarm time. Resistor R1 quickly discharges C1 when terminal 2 is open circuit. Input terminal 3 employs the same circuit as the one used on input terminal 2 so the same explanation applies.

Applying +12V to terminal 14 or 15 would trigger the long alarm time by triggering the long alarm monostable directly via R7 and D9 or R8 and D10 respectively.

If +12V is applied to terminal 16 almost the same voltage would be applied to the FET's source via R5 and the forward biased diode D7. This would bias the FET below its cut off thus disabling the inputs and the vibration detector. Applying +12V to terminal 16 also forward biases diodes D16 and D21 via R6. This permanently keeps the monostables in their stable states and also disables terminal inputs 14 and 15; the alarm is "Off". Even if the monostables are in their unstable states (Alarm activated) prior to connecting +12V to terminal 16 the alarm will quickly reset when 12V is applied to terminal 16. If terminal 16 is left open circuit or grounded the alarm is switched "On".

The mechanical vibration of the resetting relays at the end of an alarm period would produce vibration and retrigger the alarm continuously unless there is some provision to overcome this problem. Diodes D12 and D13 become forward biased during either the long or the short alarm times. They quickly charge C5 through R15 and D8 and bias the FET well below cut off. When the alarm period has expired it still takes several seconds before the source capacitor (C5) discharges through the source resistor (R11) before the normal bias voltage is restored to the FET amplifier. This time is ample to enable the relay to reset.

Applying +12V to terminal 12 will directly enable the blinker, horn/siren functions via R29 and D24. Terminal 13 provides +12V output during the long alarm time via R30 and the forward biased diode D25. Diode D26 protects against reverse supply polarity connection. Resistor R23 and Zener diode ZD1 provide over voltage protection. C10, R18 and C3 are power supply decoupling components.

# ETI — 186

## WIDE RANGE

## VOLTMETER

### Part 1



*Voltmeters come in all shapes and sizes, as demonstrated by the solid state meter presented last month. Keeping things moving, we now present over the next two issues yet another type of voltmeter. This one extends op amp technology almost to its limits by using conventional, inexpensive components to produce a voltmeter capable of measuring ac volts at frequencies over 200 kHz, with auto polarity for dc volts, and a sample and hold function. It will measure from millivolts to 1000 V (ac or dc) and fits in a jiffy box.*

#### **Peter Phillips**

REGULAR READERS of this series will know that emphasis has been on the presentation of analogue-based test equipment for the budget minded enthusiast. These days, however, it is not sufficient to 're-invent the wheel', and all the items in this series have incorporated features not available on the plethora of digital instruments that can be purchased at most electronic stores. In keeping with this philoso-

phy, the bench meter described in this article has features not usually available on either a DVM or a moving coil voltmeter. Even the expensive models of both kinds are unlikely to be able to measure frequencies beyond a few kilohertz, and with this in mind, this project was developed.

Anyone concerned with audio amplifier design or repair will know the benefits of a voltmeter that can read signals over the

audio frequency range. The classic use is determining the bandwidth of a power amplifier, in which the output is monitored while a constant value, variable frequency is applied. The cutoff points are those when the output voltage falls to 0.71 (or -3 dB) of its midrange value, and are usually determined with a CRO. However, using a CRO, if you have one, is more difficult than simply watching a pointer, which readily shows variations of fractions of a dB. For example, consider the situation in which the power output of an amplifier is set to 10 watts into a 4 ohm load using a 1 kHz input sinewave signal. The voltage across the load will be 6.32 V rms, easily measured by a meter on its 10 V scale. A change of 0.5 dB gives a voltage variation of 0.35 V, and a 1 dB change will be indicated by a variation of 0.69 V; both clearly visible with a pointer. A change of 3 dB, which is considered the smallest variation generally perceptible to the ear will be shown as a change of 1.84 volts, which looks fairly dramatic on a moving coil meter.

#### **Sophisticated Tool**

But a wide range voltmeter, although useful, needs a bit more if it is to be truly versatile. An auto polarity dc (with polarity indication) and a sample and hold feature was incorporated as well. The latter feature also doubles as a peak follower, and will store the highest value received over the test interval. Some DVMs have a sample/hold function, but usually store the value received during an internally set sample time, and lock out any further input until reset. Auto polarity is standard on the DVM, but is never found on moving coil multimeters. This useful feature prevents lead swapping, as well as S-shaped pointers due to accidental contact with a voltage of the opposite polarity to that intended.

The meter is intended for bench work, and is powered by an external plug-pack

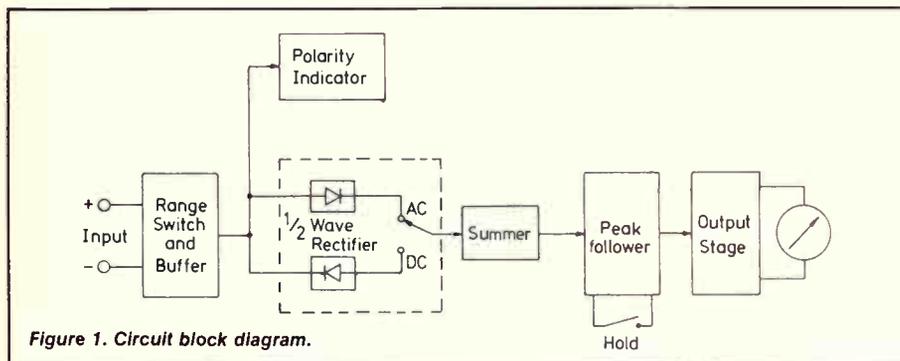


Figure 1. Circuit block diagram.

style transformer. Battery operation was considered as an option, but rejected on the presumption that this meter will fulfill a more sophisticated role than the toolbox workhorse. And of course, you may have already built the portable meter presented previously; another would be somewhat redundant. So, the final result is a bench meter that virtually completes the lineup of test equipment presented so far in this series.

## The Development Process

Examination of the circuit may give the impression that it's 'standard fare'; merely various op amp configurations strung together to give the complete system. Not so, dear reader; this one was very difficult to get right, perhaps explaining why meters of this kind are not 'off the shelf' items. It is worthwhile looking at some of the difficulties encountered in the design of this instrument, to give insight into the circuit, as well as being a useful discussion anyway.

In days gone by, the Vacuum Tube Voltmeter (VTVM) reigned supreme. These meters now have a solid state equivalent that uses FETs, and are based on a differential amplifier configuration to drive the meter movement. A characteristic of the VTVM, (and the FET VOM) is its ability to read high frequencies. The VTVM I use can read up to an incredible 2.5 MHz, and with suitable probes can be used up to 100 MHz. Commercially available FET VOMs can typically handle frequencies up to 1 MHz, and have an input impedance of 10 M ohm. However, the FET VOM is not as popular as the DVM, perhaps due to its fussiness. Like the VTVM, the meter pointer must be electrically zeroed each time it is used, and ohms measurement requires full scale as well as zero settings to be established. And, of course, it doesn't have auto polarity, nor is it particularly sensitive. The lowest range for ac volts is often 3 V, maybe 0.3 for dc volts.

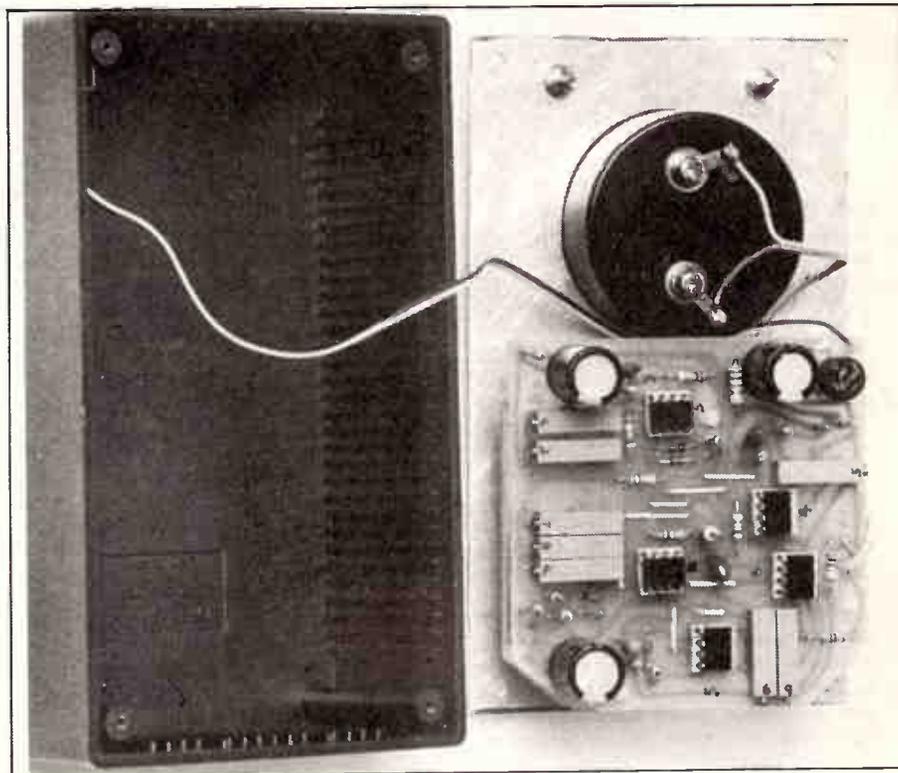
The need for auto polarity was considered important enough to warrant a new design, rather than the plagiarising of a FET VOM circuit with its differential amplifiers. The only way was to use op amps, and the final circuit has no discrete active components at all. In principle, the concept I decided upon was simple. The heart of the circuit was to be a precision full-wave rectifier, which could then be used to drive conventional dc coupled op amps. But, things were complicated by the need for exact symmetry in the rectifier for the dc auto polarity feature as well as an ability to handle the high frequencies for ac measurement. Because the development of the rectifier circuit was the most difficult, a more detailed discussion is included on this, serving also to describe this inter-

esting op amp application.

Apart from design hassles of the rectifier circuit, other difficulties included those of designing a stable multistage dc couple circuit, and minimising the effects of stray capacitance affecting the frequencies in the MHz range. After all, the capacitance values being considered are in the order of a few picofarads. But, when high impedances are present, a few picofarads becomes significant. For example, 5pF at 100 kHz exhibits an impedance of around 300k ohms, a problem when the associated resistive component is in the order of Meg ohms. Stray capacitance is present when two conductors are spaced by a dielectric, such as in switches, pcb tracks and diodes. As will be described in part two, frequency compensation is needed, and forms part of the calibration procedure, in which a piece of insulated wire, connected at one end to a point in the circuit, is used to obtain a flat response by merely moving the wire closer to an adjacent pcb track.

## The Precision Full-Wave Rectifier

A conventional full-wave bridge rectifier drops approximately 1.2 volts across the diodes, which makes it useless for low-level signal rectification. The principle of any op amp rectifier circuit is that the op amp provides the required forward bias



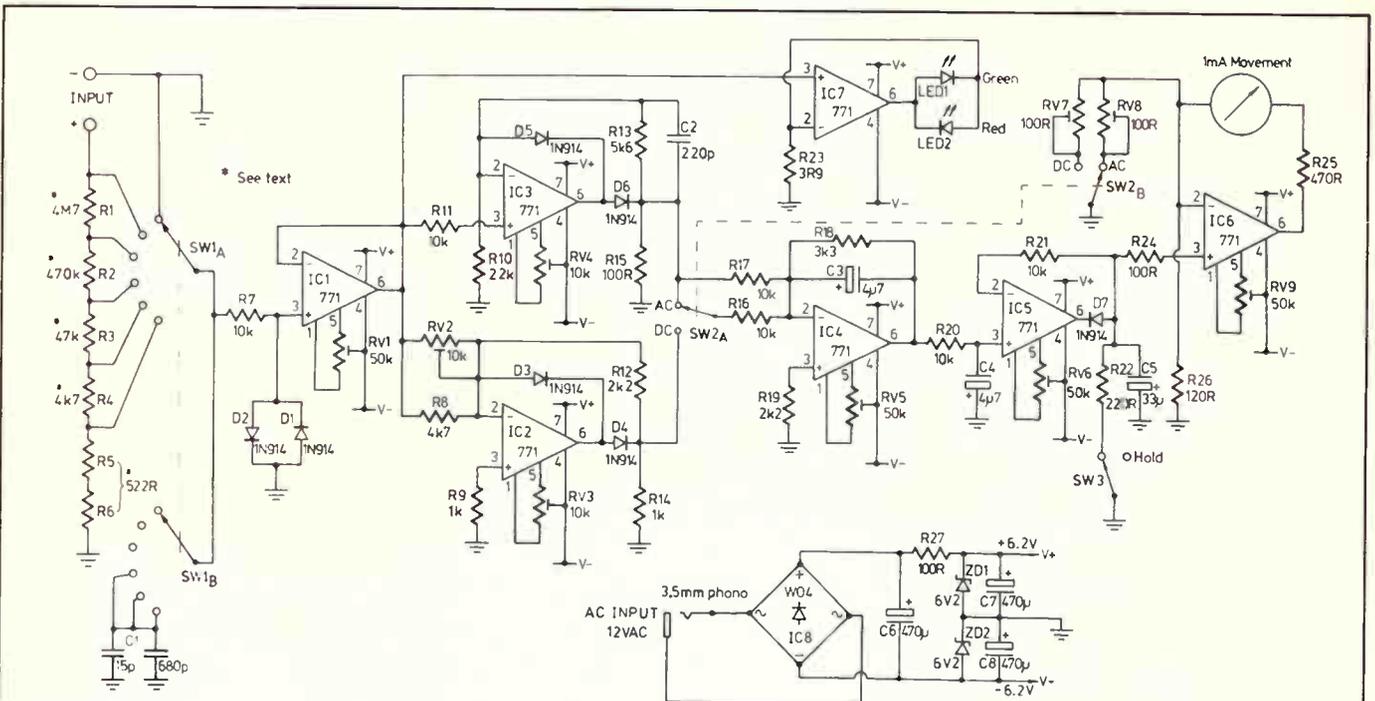
for the diodes, allowing the signal to be rectified with no losses; hence the name 'precision' rectifier. Figure 2 shows the current of a precision full-wave rectifier based on two op amps. The rectifier is associated with IC1 while IC2 is a differential amplifier that combines the two outputs of IC1 to produce the waveform shown at the output. This circuit was originally used in the development of the meter, but was found to suffer from a lack of symmetry from the dc point of view. This meant that adjusting either of the feedback resistors to give symmetry of the ac waveform still meant different gains when a dc input was applied of either polarity. It was found

that load resistors connected from points X and Y to ground improved the circuit's characteristics, but the overall performance was still inadequate. A frequency response to around 45 kHz was the best it could do, and linearity errors of up to 5% were present. Various other op amps were tried, including the 301, which allowed the application of all sorts of frequency compensation. Some improvements were obtained, but not enough to satisfy my demands. So, try again.

Figure 3 was then implemented, attractive in that it still used 2 op amps but only one diode (D1) for the rectifying action. Diode D2 is for stability when D1 is off,

by maintaining feedback around IC1. By combining the output of IC1 and an accurate portion of the input signal as the input to IC2, a full-wave output signal can be obtained. However, despite text book assurances of a high performance circuit, particularly when used with the 301 type op amp, even worse characteristics resulted. The need for exact values of all the resistors was also a restriction, as only the most dedicated enthusiast would go to the trouble required to match all these component values. So what now? I could find no other circuits in the literature, and the challenge seemed far from being solved.

I finally decided to use two individual



**How It Works**

Range selection is provided by the potential divider R1 to R6, and input protection is achieved by R7, D1 and D2. IC1 is a buffer to the input voltage from the potential divider, and has a unity gain. As already described, ICs 2, 3 and 4 form a precision full-wave rectifier, with one half (IC3) used as a half-wave rectifier when measuring ac inputs. Both rectifiers are used on 'DC', to produce an upscale deflection regardless of the input polarity. IC4 sums the outputs of both half-wave rectifiers when on 'DC', but receives the output of IC3 only when switched to 'AC'. This arrangement gives the best linearity consistent with a 200 kHz frequency response. Using the full-wave configuration for ac as well as dc still gives reasonable linearity, and has other advantages, including less 'wobble' in the meter pointer at

frequencies lower than 25 Hz. Also, it would have given a similar deflection for dc on the 'AC' range, and vice-versa. However, despite these advantages, the fact remained that linearity was compromised.

The gain of IC4 is doubled from approximately 3 to 6 when 'AC' is selected. C3 integrates an ac signal to give the average value at the output of IC4. Further filtering is provided by C4. IC5 is a peak follower, and uses C5 to store the output. When 'HOLD' is selected R22 is disconnected from ground, removing the only discharge path across C5, meaning C5 will always hold the highest value received. The meter movement is driven by IC6, such that the voltage developed across the inverting input equals that

present at the non-inverting input. The resistance to ground from the inverting input therefore determines how much current flows in the meter movement for a particular input voltage. In this way, the values of RV7 and RV8 calibrate for dc and ac respectively.

IC7 uses a similar configuration to that of IC6 to drive the polarity indication LEDs, and the LED current is determined by the value of R23. The dual polarity power supply is created from a single dc voltage provided by the full-wave rectifier IC8 by using two zener diodes, with their junction used as the common rail. This arrangement is suitable for low power circuits, but suffers from regulation problems if current values flowing in the positive and negative lines are substantially unequal.

half-wave precision rectifiers, with their outputs combined using a summer circuit. This circuit needed 3 op amps, which meant a more complex final circuit, but it had to be tried. Initial results showed an improvement, and a frequency response up to 100 kHz was achieved, with the required linearity for dc inputs. However, a conflict between linearity and frequency response was still apparent, and the compromise was still inadequate. Then, I decided to try half-wave rectification for the ac signal, by switching out the rectifier that gave the worst characteristics, and to use both rectifiers for dc inputs. The two half-wave rectifiers are, at first sight, identical, but differ in that one is driven in the inverting configuration, and the other in its non-inverting mode. The final configuration is that shown in the circuit of the meter, which shows that the half-wave rectifier of IC3 is used for ac inputs, but with an increased gain for IC4, achieved by paralleling resistors R16 and R17 when the ac condition is selected. This arrangement offers the best overall performance, and the value of the phase leading capacitor C2 allows the response to extend to 200 kHz. The values of the rectifier load resistors, R14 and R15 were selected with great care to minimise the effects of reverse leakage through the diodes, and contribute significantly to the performance of the circuit.

## Description Of The Voltmeter

The meter has seven FET input type 771 op amps and uses 2 printed circuit boards that enable the whole thing to fit into a medium size jiffy box. Construction is enhanced by having all components, including the switches, mounted on the circuit boards, with the external plug-pack transformer coupled via a phono socket.

Individual op amps, rather than dual or quad types were necessary as each amplifier, except IC7, needed a zeroing facility, unavailable on packages containing more than one amplifier. This also explains the present potentiometers, 6 of which are for amplifier zeroing. The pots need to be of the ten-turn variety as using anything else is an exercise in frustration, making calibration almost impossible. The block diagram of the circuit is shown in figure 1, in which the full-wave precision rectifier is made up of ICs 2, 3 and 4. If the sample and hold feature was not required, this block can be removed, and the output stage connected to the output stage connected to the output of the rectifier. Only three of the nine pots are used for actual calibration, in which two potentiometers are used to calibrate the output, one for ac

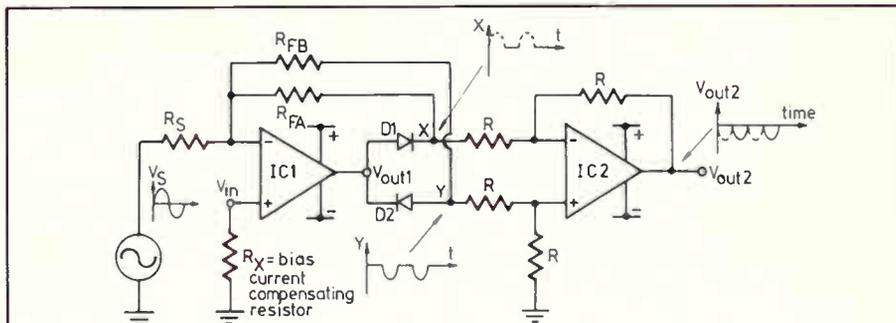


Figure 2: Full wave rectifier. It lacks dc symmetry.

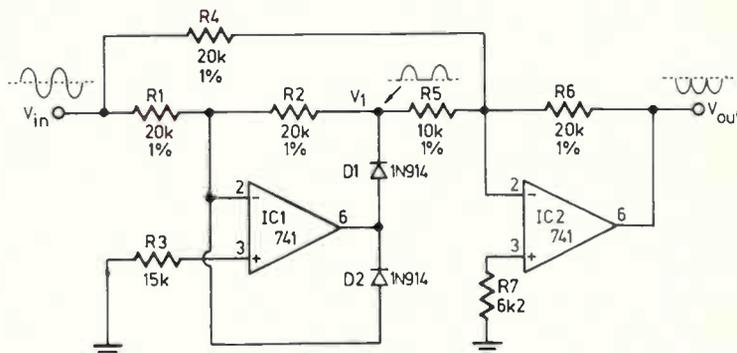
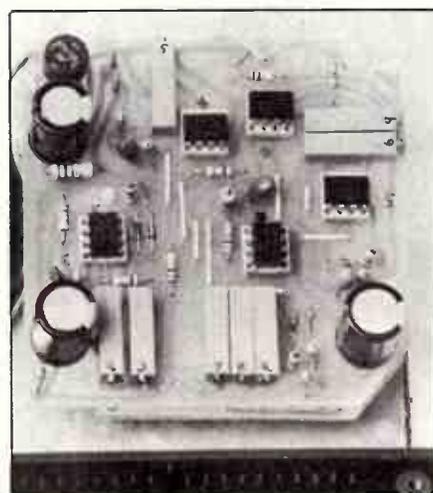


Figure 3: Our second try had even worse results!

volts and the other for dc volts. The remaining pot adjusts the symmetry of the rectifier to give equal deflection for either polarity of the dc input.

The input impedance is around 5.2M ohms, determined by the value of the resistors R1 to R6. Using higher values would still work, but difficulties arise with stray capacitance affecting the frequency response. Also, standard type high value resistors are more prone to drifting in value with age, as well as being more sensitive to temperature changes. The use of commercial laser trimmed, encapsulated potential divider resistive networks get around these problems, but costs are increased accordingly. So, a trade off has



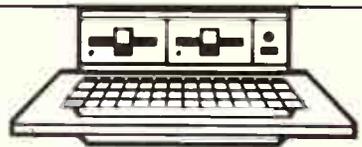
been made to retain the use of readily available components against a higher input impedance. However, if a higher input impedance is important to you, and you don't envisage using frequencies above approximately 50 kHz, then the resistors for the potential divider could probably be raised to provide an 11M ohm input impedance, by selecting a value of 10M ohm for R1, and maintaining the needed ratios for R2 to R6 as detailed later on.

The meter has 5 ranges, 100 mV, 1 V, 10 V, 100 V and 1000 V, equally applicable for both ac and dc, selected by a 6 position wafer switch. To facilitate zeroing, the first position of the switch disconnects the input socket, and shorts the input terminals of the first stage of the circuit. Apart from the 'HOLD' switch, the only other switch is the 'AC-DC' switch, implemented with a simple toggle switch. This simplifies usage, by eliminating lots of knob fiddling when changing from ac to dc measurement. AC values are displayed as RMS, (sinewave only) although I attempted to include a peak-peak feature as well. However, this proved too difficult to include without raising the complexity, and was not pursued.

So, there it is, another interesting and useful device that will offer unusual features to complement any other voltmeter you may already own. In next month's issue, full constructional details will be presented.

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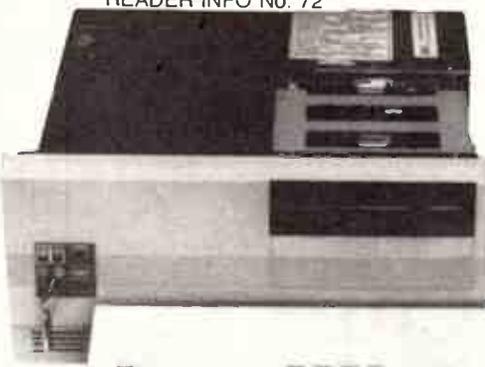
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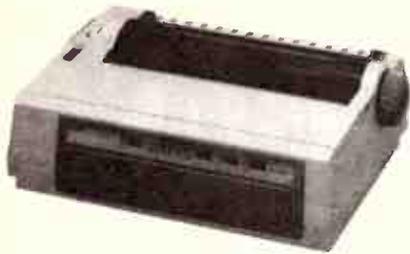
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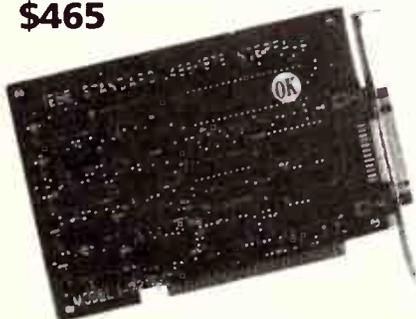
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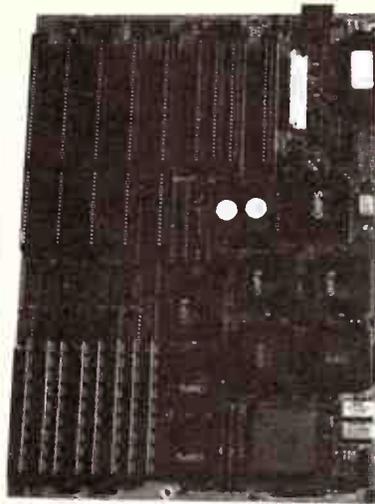
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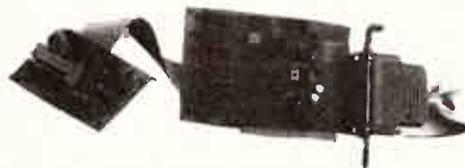
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ETI March 1988 — 83

# ETI-614 PATCH BAY

This is a super simple project that will have wide appeal to anyone who needs to rapidly reconfigure a maze of wires, whether it be in a recording studio, TV production service or even in your own lounge room.

Simon Leadley

ARE YOU SICK and tired of reaching around the back of your equipment to plug in an effect or to re-patch the mixer for mixdown? Does your home studio look more like a snake pit of leads and things? Well here is a low cost solution to

the problem: its the audio patch bay.

A patch bay is simply a connection system that allows all the connections that you are likely to use in a system to be easily accessed on a front panel. To patch from an output to a corresponding input

merely involves making the 'patch' with a short lead. A sophistication of this basic idea is to have commonly connected items (such as the stereo output of a mixer and the mixdown recorder) *normalled* via the patch bay so that unless a patch lead is plugged in the connection is automatically made to the desired piece of equipment.

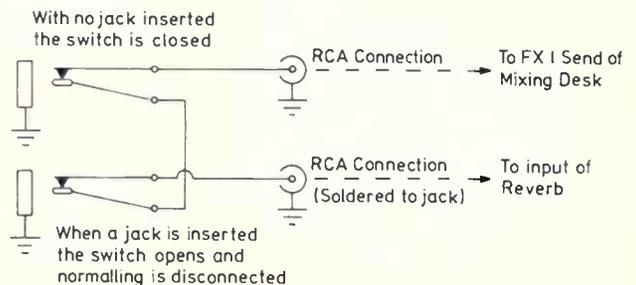
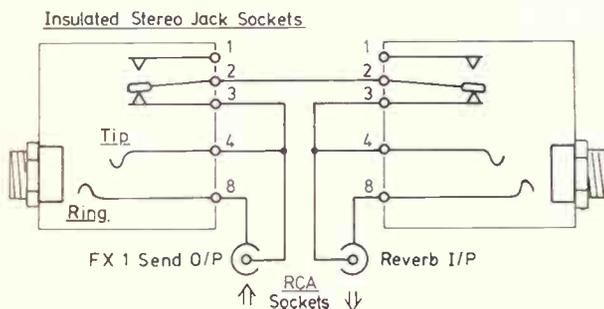
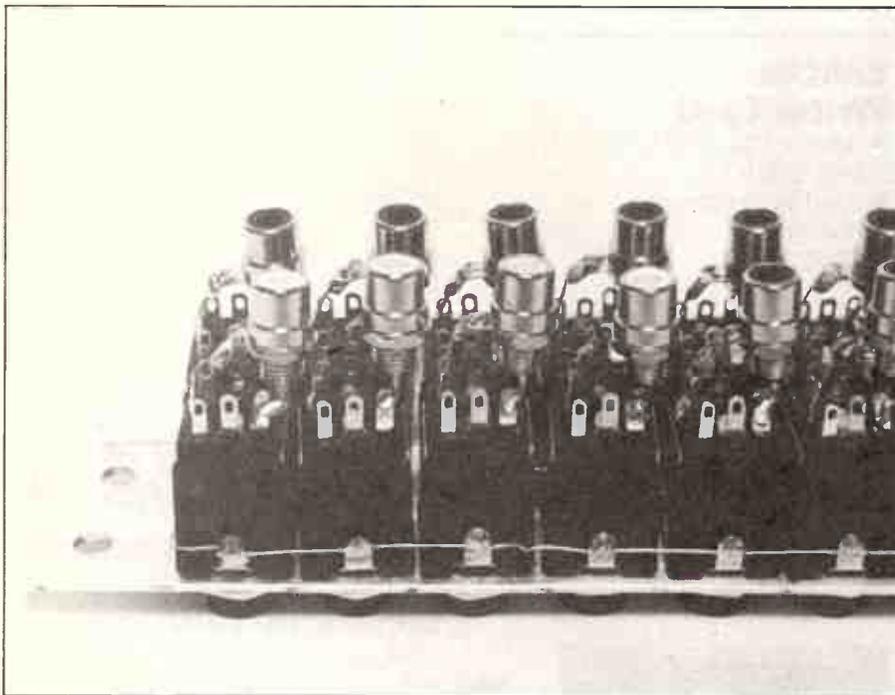
## Specifications:

The design of the patch bay uses commonly available parts that are procurable from almost any electronic store. There are 48 patch points that use the common 6.5mm jack socket and the connections to the rear of the unit are made by RCA connectors (these were chosen because they are cheap and the connections to the rear of the unit are basically hard wired connections) so that in the event of a change of the patch bay configuration it may be done simply and quickly without having to resort to a soldering iron and a huge tangle of wires.

The patch leads should be made up of suitable length screened audio cable terminated at both ends with 6.5mm mono jack plugs. It should be noted that when the mono plug is inserted into the stereo jack socket the ring connection becomes the earth.

## Construction:

The bay was constructed using commonly available angle aluminium (see diagram)



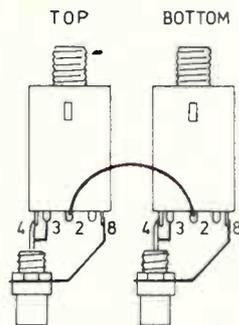
An Example of Normalizing in mono



#### Insulated Stereo Jack Socket

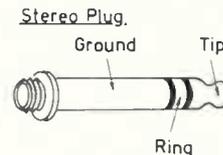
##### Connections

- 1 Normally open
- 2 Common of switch
- 3 Normally closed
- 4 Tip
- 5,6,7 N/C
- 8 Ring



#### Connection of RCA to Jack

\* Note if a mono plug is inserted into a stereo socket then the ring becomes the earth.



which is cut to the desired length and drilled with 48 holes according to the diagram (you don't have to build it with the whole complement of patch points if your requirements are more modest). Be careful when drilling the holes as the jacks are a very tight fit and any errors could mean disaster. You can brush the aluminium or paint it whichever you prefer. Next fit 24 jack sockets (the bottom ones first) and tighten them up. Bend pin 3 down so that it can be soldered to pin 4 (this saves you using a wire link). Solder the RCA socket onto the rear of the jack socket as shown in the diagram using a small wire link to connect the earth tag to pin 8. Repeat for the top row of sockets. Now the unit is actually complete all you need to decide is which connections need to be normalised.

#### Normalised Connections

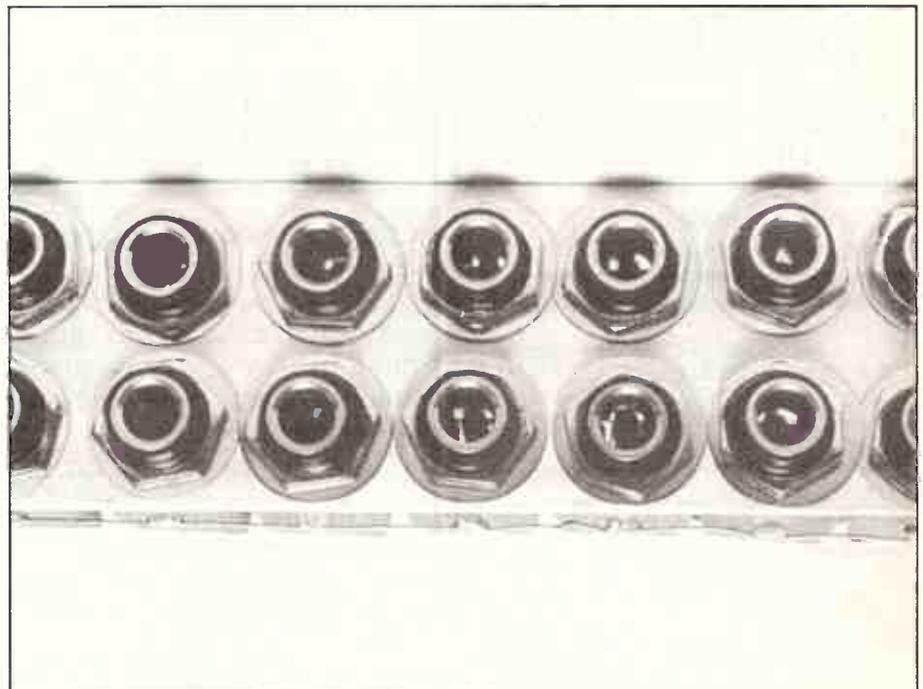
In order to make things easy for ourselves in the recording situation we com-

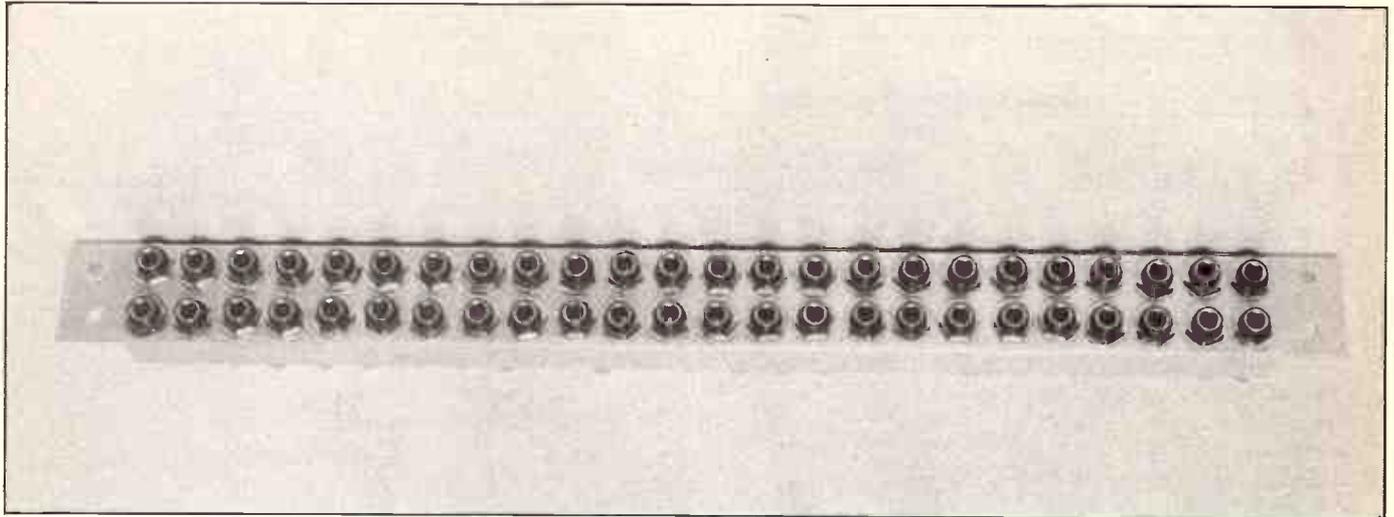
monly have some pieces of equipment set up the same way eg. the reverb unit is always connected to FX send 1 and returns into the line inputs of channels 1 & 2 (in stereo of course) on the desk. Now it seems a waste to always have three patch leads always plugged in, so we use the patch bay and the particular type of sock-

ets to perform what is commonly referred to as normalising. Each of the 6.5 mm jack sockets that we purchased has a switch that is opened by pushing a plug into the socket. When no plug is plugged in the switch is closed. If we connect the output of FX send 1 via the switch on the socket to the REVERB IN socket (also via the

#### COST & PARTS

I got all of my parts from Jaycar (except the aluminium which was from the local Mitre 10). I used stereo insulated 6.5mm jack sockets and the panel mounting RCA sockets. These were cheap and available from a number of different electronic outlets. The whole project cost around \$130.00 for the 48 point patch bay which is less than half commercial units which don't include the ability to normalise the sockets. It is easy to build and flexible. Just build to what you need. Happy patching!





switch on its respective socket) then the connection is said to be normalled, i.e. with no plugs plugged into those sockets the signal will be sent from FX1 to the input of the reverb unit.

What happens if you wish to use FX1 as a delay send instead of a reverb send? Simple, just use a patch lead to make the desired connection and the normalled connection is broken. Simple huh!

I suggest that you actually use the patch box for a while before deciding how you wish to configure it. This will save a lot of time and effort if you need to change anything. Quite often the insert send/receives on a desk are brought up to the patch bay so that an FX may be inserted into a channel rather than via an AUX/FX send. When you do this it is important that they be normalled so that when an insert is not

being used the signal path is not interrupted. It would be a good idea when you connect the pieces of equipment to the patch bay to mark each lead for easy identification. This will make it much easier to trace faults as well as any changes that may be made later on.

*Simon Leadley is with Trackdown Studios. Ph (02) 387 2621.*

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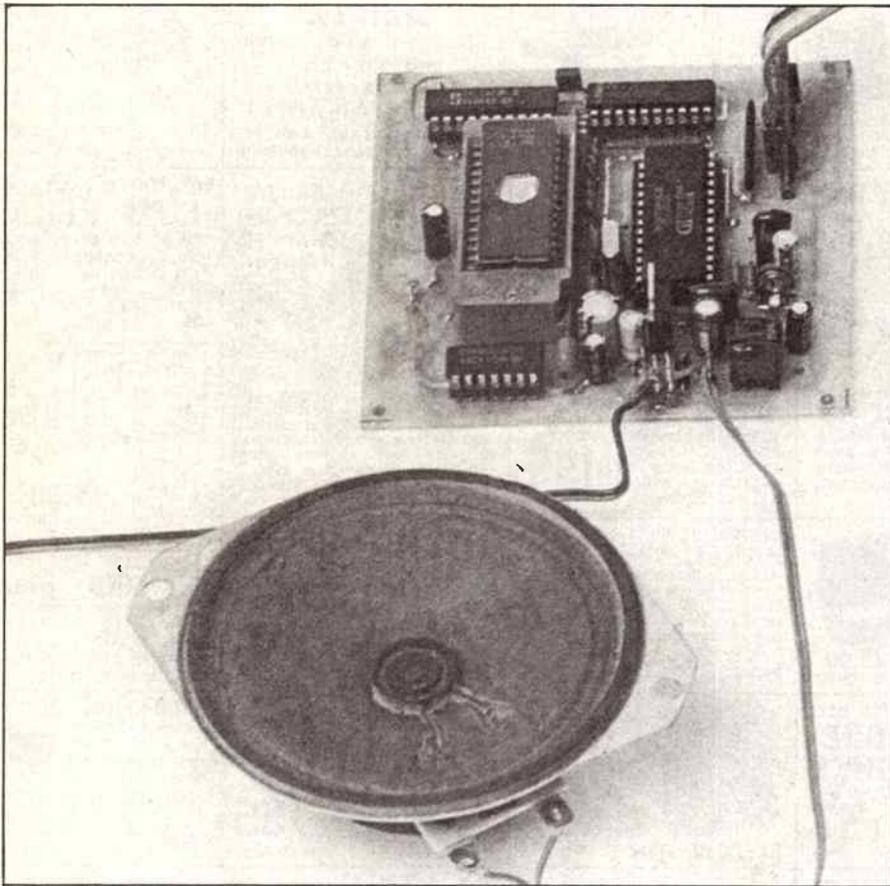
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CR2430 **\$6.25**  
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# ETI-1610 SPEECH CONTROLLER

Dave Thompson



Have you always wanted to own a talking car, or to add some life to your household appliances by giving them a voice, but are a little worried about the practicality of shoving a Commodore 64 under the passenger seat or finding room inside your toaster for a VZ 200? . . . Well worry no more, the stand-alone speech synthesizer is here!

THERE HAVE BEEN many designs published in hobby electronics magazines for speech synths, but all of these require a computer to generate the words. This means that to get your pride and joy to speak, you have to buy not only a speech

synth but a computer as well . . . not to mention the worries of interfacing the car door light switch to the micro!

For this reason, the "Stand-alone speech synthesizer" (SSS) was created.

It uses only seven standard IC's, is pow-

ered by any decent dc source, and should cost less than \$50 to complete.

The SSS features up to 256 messages each of 128 bytes length, each byte corresponding to an "allophone" or speech element. 128 bytes is more than enough for most short sentences. Indeed the longest I have ever needed was 31 bytes long and formed the sentence "You've left the lights on".

Messages are created by programming them into an EPROM, which you can do yourself, or alternatively you can purchase one, pre-programmed with 56 common sentences. The method of creating messages will be discussed later on.

The maximum number of messages is limited by the EPROM you choose.

If you use a 2764 (8K x 8), you will get 63 messages, 27128 (16K x 8) will give you 127 messages and a 27256 (33K x 8) will reward you with 255 messages. Which one you use is limited by how many messages you think you want and how much you want to spend on EPROMS . . . The 2764 is cheap and offers quite a few messages, more than enough for most purposes, and will be used in the circuit discussed.

## Construction

Commence construction by having a good look at the printed circuit board. There are quite a few tracks that come very close together, so make sure there are no shorts between these. Check also for hairline cracks on all the copper tracks. If you spot one now, it could save you hours of frustration later.

The Board is double-sided but not plated through. To get around this, some components must be soldered on both sides of the board and some small wires soldered into the through-holes to provide connections between the two sides. The component overlay identifies the through-holes and pins that need to be soldered on both sides.

The through holes and the resistors should be installed first, followed by sockets for the IC's if you choose to do so. I strongly recommended you use sockets for IC3 and IC4. The prototype had a ZIF (Zero inser-

tion force) socket for the EPROM as much testing was envisaged. If you don't wish to use such an expensive socket, at least use the best standard one you can find, as cheap ones have been known to fall apart with continuous use!

As many pins on IC6 and IC7 need to be soldered on the component side, you must either solder them in directly or use molex pins.

Follow these with the capacitors, D1, the trimpot and the crystal. Finally solder IC1 and the header pins (J2, J3) in place.

You can now plug the socketed IC's in. This method of going from the lowest-profile components to the tallest, greatly simplifies construction and avoids damage to components during construction.

Check the orientation of all the polarized components with the overlay with special attention to the electrolytics and IC's.

Connect an 8 ohm speaker, some form of 12Vdc power supply and you're ready to go!

## Testing

Before plugging the SPO-256 or the EPROM in, you should do a smoke test . . . ie: turn the thing on and run for cover . . . Providing all is well, nothing should happen other than a small click emanating from the speaker.

Now, go around the circuit and test that all the devices have power at the right places and that the voltage is close to +5 volts. If not, switch off and check for shorts.

If all is well, disconnect the power supply and carefully plug in the SPO-256 and the EPROM. Power it up and make sure the volume control is advanced enough to be audible. (A quick note here . . . to see if the audio amp is working, carefully touch the

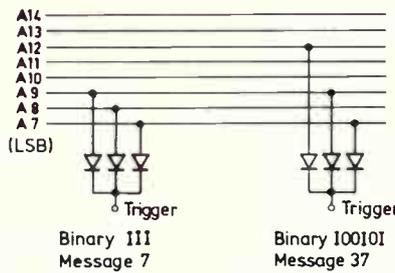
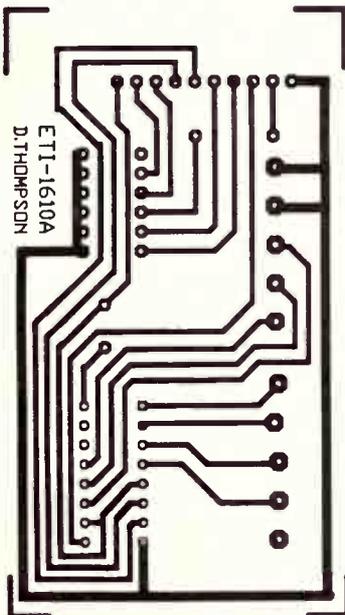


Figure 1

Note Input lines are inverted by IC7 to give the shown Binary Message. Message is selected when Trigger is taken Low.

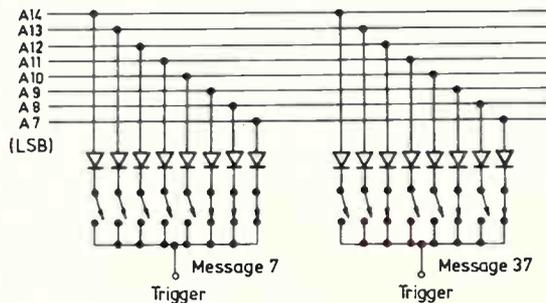


Figure 2

## Decoding the input lines

The inputs to the SSS are binary. This means the eight input lines give you 256 combinations. Obviously if they were all decoded on board, the board size and complexity would be increased to ridiculous proportions. The average user may only want a few of the messages and for this reason the lines are left this way. Decoding the inputs can be very easily done by selecting combinations of lines and connecting them to ground. This can be done in several ways.

### Method 1: Simple diodes

Figure 1 shows how, by connecting diodes to the lines you need to pull low, a message may be found by joining the collective cathodes to ground. By this method, you could carry an eight-way ribbon cable around a car (for instance) and whenever a contact was needed you would simply connect diodes to the necessary lines to get the combination.

### Method 2: Adjustable pre-decoded

Figure 2 shows a different way of obtaining messages. A small board plugging into the message select header contains four or so DIP switches each connected to eight diodes. You simply select which message you would like to be decoded on the DIP switches and a single wire will then trigger the selected message.

### Method 3: Priority decoded subset

The first two methods have a problem in that if more than one message is selected at the same time, a totally different result will occur! Method two also

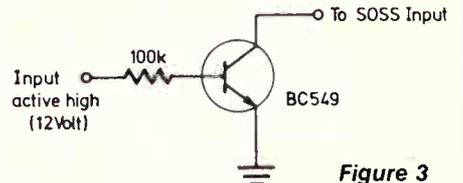


Figure 3

has the problem of a limited number of available messages

Method three takes advantage of the pre-programmed EPROM's grouping of messages that are similar in application . . . ie: All the messages dealing with cars are grouped together, etc.

To fully utilize this, Method 3 has a small DIP switch which controls the upper address lines, and an eight-line-to-three BCD encoder chip to control the lower ones.

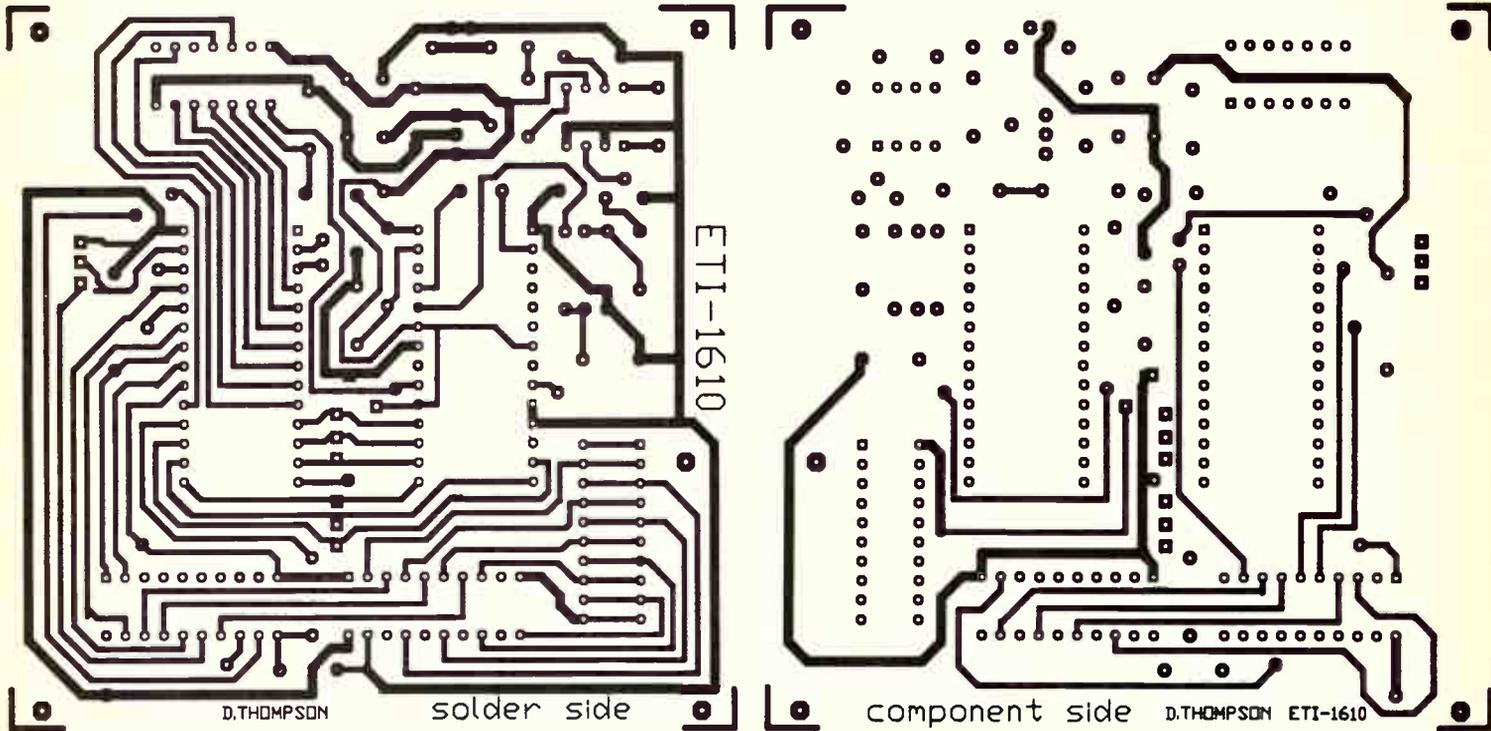
What this means is that you can select the application on the DIP switch, and then all the seven or so relevant messages appear fully decoded on the inputs of the encoder chip. Another feature of this method is that the lines are encoded with priority, that is if two or more messages have been selected, only the highest priority is spoken.

A great application of this is where you would have the over-temperature alarm connected to the highest priority and, say, a door switch connected to the lowest, so that if an over-temperature situation occurred, it would not be masked by a silly door message.

### More on Inputs:

The inputs are active low, as mentioned above. If your application requires them to be active high, just replace the 74LS240 with a 74LS244 and reverse R6 so that the spot goes to the opposite end hole (ground).

Another way of dealing with an active high signal is to invert and translate it with a transistor as shown in Fig 3.



If you don't have access to an EPROM programmer, you can purchase one pre-programmed with 56 commonly available messages. These are listed in Table 1.

**Standard Vocabulary for 2764 . . . (eight applications, eight per appin)**

**Block 1 Car:**

- 0: \*\*\*\*\*Invalid\*\*\*\*\*
- 1: I'm overhauling
- 2: Oil Pressure Warning
- 3: Fuel Low
- 4: Alternator failure
- 5: Brakelight failure
- 6: You've left the lights on
- 7: A door has been left open

**Block 2 Combination lock:**

- 0: \*\*\*\*\*Invalid\*\*\*\*\*
- 1: Enter the combination
- 2: Incorrect, try again
- 3: Correct you may open the door
- 4: Correct you may start the engine
- 5: Change combination
- 6: New combination recorded
- 7: Locked

**Block 3 Home:**

- 0: \*\*\*\*\*Invalid\*\*\*\*\*
- 1: Alarm activated
- 2: Alarm deactivated
- 3: Alarm triggered
- 4: A window or door has been left, open
- 5: There is someone at the front door
- 6: There is someone at the back door
- 7: A car is entering the driveway

**Block 4 Lift:**

- 0: \*\*\*\*\*Invalid\*\*\*\*\*
- 1: First Floor
- 2: Second Floor
- 3: Third Floor
- 4: Fourth Floor
- 5: Fifth Floor
- 6: Sixth Floor
- 7: Seventh Floor

**Block 5 Appliances and Lift Cont:**

- 0: \*\*\*\*\*Invalid\*\*\*\*\*
- 1: Eighth Floor
- 2: Ninth Floor
- 3: Tenth Floor
- 4: Going Up
- 5: Going Down
- 6: Toast ready
- 7: Toast done

**Block 6 More Appliances:**

- 0: \*\*\*\*\*Invalid\*\*\*\*\*
- 1: Coffee's ready!
- 2: Tea is served . . .
- 3: Another cup already?
- 4: Dinner's ready
- 5: Oven temperature reached
- 6: Timer Set
- 7: Selected time reached

**Block 7 General:**

- 0: \*\*\*\*\*Invalid\*\*\*\*\*
- 1: On
- 2: Off
- 3: Empty
- 4: Warning, overload conditions exists
- 5: Process beginning
- 6: Process completed
- 7: Full

**Block 8 Testing, assorted:**

- 0: \*\*\*\*\*Invalid\*\*\*\*\*
- 1: Reset test . . . your reset is not working!
- 2: Hello
- 3: Danger
- 4: It's cold outside
- 5: It's a sunny day
- 6: Latch disabled . . . this message should be intermittent!
- 7: Latch testing . . . this message cannot be stopped!

trimpot wiper with your finger. This should inject enough noise into the circuit to test it.)

Connect a combination of inputs to ground. Any one of them will do. Which ones you select will determine what message you will hear. As soon as the inputs are pulled low, a message should start and be spoken.

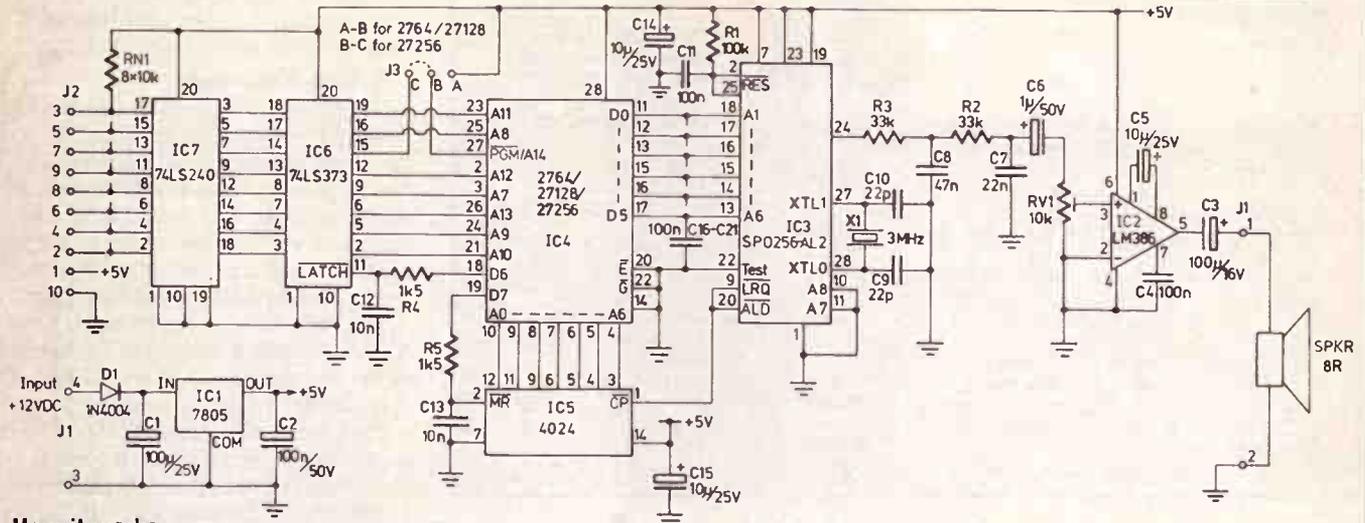
The simplest way to test the device is with the pre-programmed EPROM. It has three messages dedicated to testing all the functions and circuitry of the SSS. The test messages can be found in block eight (see standard vocabulary for 2764)..

Message number seven is designed to test the latching circuit. When this message is selected, it should run continuously and be unstoppable even if you select another message. The message tells the circuit to hold the current address and not release it even on completion of the message.

Message number six compliments the above message by doing the opposite. The latching circuit is disabled and the message should stop as soon as you release the input that you selected.

If either of the above fails then something is wrong with the latching circuit. The only things that could affect this are the latch (74LS373), the tracks between the EPROM and the latch, or a badly programmed EPROM.

Message number one checks the reset circuitry. The message explains itself. The EPROM tells the counter to reset halfway



## How it works

The circuit is based around, and driven by, the SP0256-AL2 speech chip and the EPROM, which for the purposes of simplicity will be defined as a 2764. The operation of the circuit is the same no matter what EPROM type you choose to use.

The SP0256 has an output called /LRQ. When this is asserted, the SP0256 expects a 6-bit address to be placed on its address lines corresponding to the sound you want it to make. An input, called /ALD, loads the address into the SP0256 and the sound is generated.

If these two lines are joined together, the device becomes self-triggering and will keep loading and speaking any sound address that is placed on the address buss. It also generates a useful signal that we will use to sequence the sentence through the speech chip.

To sequence the data through the speech chip, a counter is used to drive the lower 7 address lines of the EPROM. The clock for the counter is derived from the joining of the /ALD and /LRQ lines on the SP0256. This sends an active low pulse every time the speech chip wants a new sound. This pulse increments the counter and the next byte is placed on the bus.

The SP0256 only requires data to be 6 bits in length. This means that there are two unused bits at every address of the EPROM. In developing this device I discovered that all the external logic could be made redundant if the EPROM was made to control the remaining circuitry, rather like a PAL.

Since the messages are not all going to be 128 bytes in length, some way is needed to reset the counter when the message is finished. This is accomplished by connecting the reset input of the counter to the unused most significant bit of the EPROM (D7). When you want the counter to reset you simply

put a value in the EPROM that causes D7 to assume the active state. To prevent false triggering, R-C networks are used in these lines to filter out unwanted spikes that would otherwise upset the circuitry.

Selection of the messages are made by pulling the input lines low. These are converted to active high signals by the inverter chip and latched by the 74LS373. The latched address is then applied to the upper eight address lines of the EPROM, forming an "offset" to the sequencing that is going on around the lower seven address lines. The message address needs to be latched otherwise a message that has been triggered by an intermittent event will only last as long as the event and may not be noticed.

The latching is accomplished in the same way as the counter reset, this time using the unused seventh data bit (D6). As the 373's latch input is active low, the device is held in its latched state which the message is running and is unlatched as soon as the message is completed or when the device is in the idle state, waiting for an input.

In order to simplify the circuitry, the first address area, 0-7F Hex is not able to be addressed and is used to make the circuit "listen" for an input. It operates as follows.

When no input is applied to the circuit, the circuit cycles endlessly in the first byte. Since a C0 Hex is placed here and in the next 7E Hex bytes, the circuitry is told to reset the counter and unlatch the latch. All this time the EPROM is sending a string of 00's to the SP0256 which corresponds to a 10ms pause, so no sound is heard.

As soon as an input is applied to the device, the cycling is moved away from address 00 and starts at the base address of the message selected. Since this consists of the value 40 Hex, the

counter is no longer being reset and begins incrementing, and your message starts being spoken.

At the termination of the message, the latch is released and the counter is reset; providing no new input has been connected, the device will return to the idle state, awaiting a new message.

The clock input is derived from a 3.0 Mhz crystal, giving a nice deep voice. The data sheet recommends using a 3.12 Mhz crystal, but I have used up to a 3.57 Mhz crystal, resulting in a higher pitched voice, with no foul consequences.

Speech output is smoothed by an R-C network and is passed to the audio amp chip, the LM386, set to a gain of 200. Volume control is achieved by the 10k trimpot.

The circuit can use any one of three different types of EPROM. A jumper (J3) is used to connect the highest address line (A14) to the latch outputs, (if a 27256 is used), or to five volts if a 2764 or 27128 is used.

The circuit relies on the timing delays of the EPROM. It was discovered during development of the prototype that fast EPROM's upset the timing of the circuit and could cause erratic operation. To fix this, a simple but effective solution was contrived. Since the access time of most memory devices is limited by the line capacitance, if you increase this externally, the access time is reduced considerably. A fast EPROM becomes a slow one, and a slow one gets slower. To achieve this, a 0.1  $\mu$ F capacity is placed on each data line of the EPROM.

A five volt supply is generated by a 7805 voltage chip, smoothed by C1 and C2.

The SP0256's reset circuitry is automatic once operating, but to assure correct operation on power-up, the lines are held low for a short time by virtue of the R-C network R1 and C11.

## Parts list:

<b>Resistors</b> .....all 1/4 W, 5%	IC1.....7805 5 volt regulator
R1.....100 K	IC2.....LM386 Audio Amplifier
R2, 3.....33 K	IC3.....SP0256-AL2 Speech Synth (Rod Irving, Tandy)
R4, 5.....1K5	IC4.....EPROM (either 2764, 27128, 27256)
RN1.....10 K 8 SIP Resistor pack	IC5.....4024 Counter
RV1.....10 K Mini Vertical Trimptot	IC6.....74 LS 373 8-bit latch
<b>Capacitors</b>	IC7.....74 LS 240 8-bit inverter
C1.....100 µF Electrolytic 25 volts	<b>Miscellaneous</b>
C2.....100n RBLL Electro 50 volts	PCB.....ETI-1610a, ETI-1610b
C3.....100 µF Electrolytic 16 volts	SPKR.....8 Ohm 1 Watt
C4, 11.....100n Greencap	J2.....10-way Pin header (2" Jaycar HM-3210 8-way)
C5.....10 µF Electrolytic 25 volts	X1.....3.0 MHz Crystal (Jaycar RQ-5271)
C6.....1 µF Electrolytic 50 volts	Sockets.....40 Molex pins
C7.....22 nF Greencap	Sockets.....1x8 way
C8.....47 nF Greencap	Sockets.....2x28 way
C9, 10.....22 pF Disk Ceramic	Sockets.....1x14 way
C12, 13.....10 nF Disk Ceramic	
C14, 15.....10 µF Electrolytic 25 volts	
C16 to 21.....100 nF Monolythic caps	
<b>Semiconductors</b>	
D1.....1N4004 Diode	

IC1.....7805 5 volt regulator
IC2.....LM386 Audio Amplifier
IC3.....SP0256-AL2 Speech Synth (Rod Irving, Tandy)
IC4.....EPROM (either 2764, 27128, 27256)
IC5.....4024 Counter
IC6.....74 LS 373 8-bit latch
IC7.....74 LS 240 8-bit inverter
<b>Miscellaneous</b>
PCB.....ETI-1610a, ETI-1610b
SPKR.....8 Ohm 1 Watt
J2.....10-way Pin header (2" Jaycar HM-3210 8-way)
X1.....3.0 MHz Crystal (Jaycar RQ-5271)
Sockets.....40 Molex pins
Sockets.....1x8 way
Sockets.....2x28 way
Sockets.....1x14 way

through the message. If you hear the last part of the message, then your reset circuitry is not working. Possible causes of this

are the counter (4024), the tracks between it and the EPROM, and, again, an incorrectly programmed EPROM.

## Some example messages:

Here are some tried and tested messages that you may like to use to help in the testing of the SSS.

The following generates the sentence "I'm overheating".

Address (Hex)	Value (Hex)	Sound	Comment
80	40	10ms pause	Unlatch latch and start
81	06	AY	I
82	10	MM	M
83	02	50ms pause	
84	35	OW	O
85	23	VV	V
86	33	ER1	ER
87	1B	HH1	H
88	13	IY	EE (It's how it sounds!!)
89	11	TT1	T
8a	0C	1H	I
8b	2C	NG	NG
8c	04	200ms pause	
8d	04	200ms pause	These pauses create a 2
8e	04	200ms pause	second gap at the end of the
8f	04	200ms pause	message. It isn't needed but
90	04	200ms pause	makes it bearable when it
91	04	200ms pause	repeats on and on and on . . .
92	04	200ms pause	
93	04	200ms pause	
94	04	200ms pause	
95	04	200ms pause	
96	CO	10ms pause	Unlatch and reset counter

"You left the lights on!"

40	19	1F	23	00	2D	07	28
11	00	12	33	00	2D	06	0D
37	02	18	0B	04	04	04	04
04	04	04	04	04	04	04	C0

"Hello"

40	1B	07	2D	(No finishing pause in this one, just to show that it's OK			
35	C0	. . . It will just sound like. "hellohelloworld" . . . all run together)					

"Stand by"

40	37	0D	1A	0B	15	02	1C
18	06	04	04	04	04	04	C0

"Enter the combination"

40	07	0B	0D	33	02	12	33
02	08	18	10	3F	0C	38	14
25	0B	04	04	04	04	04	C0

"I'm running on empty"

40	06	10	02	0E	0F	0B	0C
2C	02	18	0B	02	07	10	09
0D	13	04	04	04	04	04	C0

Once the SSS has passed all these tests, you are ready to make your own messages and put the thing into service!

## Creating a message

To create a message, all you have to do is work out what sounds you need to create the words that form your sentence. Included in this article is a listing of all the sounds supported by the SP0256 chip, examples of what the sounds sound like when used in words, and the values you need to put in your EPROM to get these sounds.

The only thing to remember is to put a 40 Hex (01000000 Binary) at the beginning of the message and CO Hex (11000000 Binary) at the end of the message.

Each message starts at 80 Hex intervals, ie: the first at 80 Hex, the second at 100 - Hex, then 180 Hex, then 200 Hex, etc, etc.

For reasons discussed later, the first message area (0-7F Hex) must be filled with CO Hex. If you use the expansion board, the first message area in EVERY block must be similarly filled.

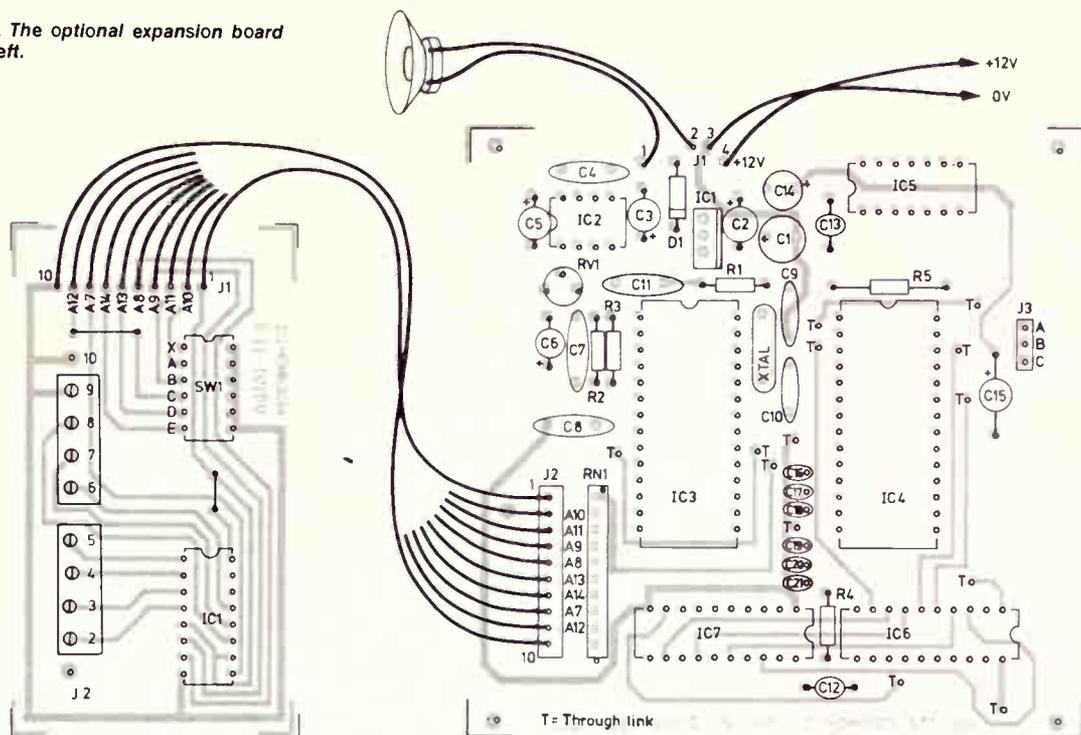
DEC. Address	OCT. Address	HEX. Address	ALLOPHONES.	SAMPLE WORD	DURATION
0	000	0	PA1	Pause	10MS
1	001	1	PA2	Pause	30MS
2	002	2	PA3	Pause	50MS
3	003	3	PA4	Pause	100MS
4	004	4	PA5	Pause	200MS
5	005	5	/OY/	OY in boy	420MS
6	006	6	/AY/	Y in sky	280MS
7	007	7	/EH/	E in End	70MS
8	010	8	/KK3/	C in Comb	120MS
9	011	9	/PP/	P in Pov	210MS
10	012	A	/JH/	G in dodGe	140MS
11	013	B	/NN1/	N in ThIN	140MS
12	014	C	/IH/	I in sIt	70MS
13	015	D	/TT2/	T in To	140MS
14	016	E	/RR1/	R in RuRl	170MS
15	017	F	/AK/	U in sUccess	70MS
16	020	10	/NR/	M in Mlk	180MS
17	021	11	/TT1/	T in perT	100MS
18	022	12	/DH1/	TH in They	290MS
19	023	13	/IY/	E in sEE	280MS
20	024	14	/EY/	EI in bEige	280MS
21	025	15	/DD/	LD in covLD	70MS
22	028	18	/UW1/	O in cO	100MS
23	027	17	/AO/	AU in Aught	100MS
24	030	18	/AA/	O in nOt	100MS
25	031	19	/YY2/	YE in YEa	180MS
26	032	1A	/AE/	A in hAT	120MS
27	033	1B	/HH1/	H in He	130MS
28	034	1C	/BB/	BU in BUiness	80MS
29	035	1D	/TH/	TH in ThIn	180MS
30	038	1E	/UH/	OO in bOOk	100MS
31	037	1F	/UR2/	OO in rOOd	260MS
32	040	20	/AF/	OU in OUt	370MS
33	041	21	/DD2/	D in Do	160MS
34	042	22	/GG3/	G in vIG	140MS
35	043	23	/VV/	V in Veat	190MS
36	044	24	/GG1/	GU in GUest	80MS
37	045	25	/SH/	S in ShIP	180MS
38	048	26	/ZH/	Z in sZure	190MS
39	047	27	/RR2/	R in bRIn	120MS
40	050	28	/FF/	F in Food	150MS
41	051	29	/KK2/	K in sKv	190MS
42	052	2A	/KK1/	C in Can't	180MS
43	053	2B	/ZZ/	Z in Zoo	210MS
44	054	2C	/NG/	N in nChor	220MS
45	055	2D	/LL/	L in Leko	110MS
46	058	2E	/Ww/	W in wool	180MS
47	057	2F	/XR/	R in Repair	260MS
48	060	30	/WH/	W in whIG	200MS
49	061	31	/YV1/	Y in YeS	100MS
50	062	32	/CH/	C in Church	190MS
51	063	33	/ER1/	IR in fIR	160MS
52	064	34	/ER2/	ERR in fIRR	300MS
53	065	35	/OW/	AU in sEAU	240MS
54	066	36	/DH2/	TH in They	240MS
55	067	37	/SS/	S in veSt	60MS
56	070	38	/NH2/	N in No	190MS
57	071	39	/HH2/	H in Hoe	180MS
58	072	3A	/OR/	OR in sTORe	330MS
59	073	3B	/AR/	A in aLAr	290MS
60	074	3C	/YR/	R in cleAR	260MS
61	075	3D	/GG2/	G in Got	40MS
62	076	3E	/EL/	L in sEdDLe	190MS
63	077	3F	/BB2/	B in BUy	60MS

DEC. Address. OCT. Address. HEX. Address. ALLOPHONES. SAMPLE WORD. DURATION

GUIDELINES FOR USING THE ALLOPHONES.

# SPEECH CONTROLLER

Overlay diagram. The optional expansion board is shown at the left.



## GENERAL INSTRUMENTS' SPO256-AL2

### Silence

- PA1 (10 ms) before BB, DD, GG, and JH
- PA2 (30 ms) before BB, DD, GG, and JH
- PA3 (50 ms) before PP, TT, KK, and CH, and between words
- PA4 (100 ms) between clauses and sentences
- PA5 (200 ms) between clauses and sentences

### Short Vowels

- \*/IH/ sitting, stranded
- \*/EH/ extent, gentlemen
- \*/AE/ extract, acting
- \*/UH/ cookie, full
- \*/AO/ talking, song
- \*/AX/ lapel, instruct
- \*/AA/ pottery, cotton

### Long Vowels

- /IY/ treat, people, penny
- /EY/ great, statement, tray
- /AY/ kite, sky, mighty
- /OY/ noise, toy, voice
- /UW1/ after clusters with YY: computer
- /UW2/ in monosyllabic words: two, food
- /OW/ zone, close, snow
- /AW/ sound, mouse, down
- /EL/ little, angle, gentlemen

### R-colored Vowels

- /ER1/ letter, furniture, interrupt
- /ER2/ monosyllables: bird, fern, burn
- /OR/ fortune, adorn, store
- /AR/ farm, alarm, garment
- /YR/ hear, earring, irresponsible
- /XR/ hair, declare, stare

### Resonants

- \*/WW/ we, warrant, linguist
- \*/RR1/ initial position: read, write, x-ray
- \*/RR2/ initial clusters: brown, crane, grease
- \*/LL/ like, hello, steel
- \*/YY1/ clusters: cute, beauty, computer
- \*/YY2/ initial position: yes, yarn, yo-yo

### Voiced Fricatives

- /VV/ vest, prove even
- /CH1/ word-initial position: this, then, they
- /CH2/ word-final and between vowels: bathe, bathing
- /ZZ/ zoo, phase
- /ZH/ beige, pleasure

### Voiceless Fricatives

- \*/FF/ These may be doubled for
- \*/TH/ initial position and
- \*/SS/ singly in final position
- /SH/ shirt, leash, nation
- /HH1/ before front vowels: YR, IY, IH, EY, EH, XR, AE
- /HH2/ before back vowels: UW, UH, OW, OY, AO, OR, AR
- /WH/ white, whim, twenty

### Voiced Stops

- \*/BB1/ final position: rib; between vowels: fibber; in clusters: bleed, brown
- \*/BB2/ initial position before a vowel: beast
- \*/DD1/ final position: played, end
- \*/DD2/ initial position: down; clusters: drain
- \*/GG1/ before high front vowels: YR, IY, IH, EY, EH, XR
- \*/GG2/ before high back vowels: UW, UH, OW, OY, AX; and clusters: green, glue
- \*/GG3/ before low vowels: AE, AW, AY, AR, AA, AO, OR, ER; and medial clusters: anger; and final position: peg

### Voiceless Stops

- \*/PP/ pleasure, ample, trip
- \*/TT1/ final clusters before SS: tests, its
- \*/TT2/ all other positions: test, street
- \*/KK1/ before front vowels: YR, IY, IH, EY, EH, XR, AY, AE, ER, AX; initial clusters: cute, clown, scream
- \*/KK2/ final position: speak; final clusters: task
- \*/KK3/ before back vowels: UW, UH, OW, OY, OR, AR, AO; initial clusters: crane, quick, clown, scream

### Affricates

- \*/CH/ church, feature
- \*/JH/ judge, injure

### Nasal

- \*/MM/ milk, alarm, ample
- \*/NM1/ before front and central vowels: YR, IY, IH, EY, EH, XR, AE, ER, AX, AW, AY, UW; final clusters: earn
- \*/NM2/ before back vowels: UH, OW, OY, OR, AR, AA
- \*/NG/ string, anger

\*These allophones can be doubled.

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## OUT NOW

### Expansion Board

Here follows a description of an expansion board for the SSS. It is briefly described under the heading of "Method 3" in the description of the SSS.

Access to the messages is a little trickier than it could be by virtue of the fact that the input lines to the SSS expect a binary input. IE: To get message seven you would have to hold inputs four, five and eight to ground.

This expansion board allows you to access any individual message in eight groups of seven messages in the pre-programmed EPROM or your own EPROM. Not only do you then get easy access to seven messages of similar application, but the seven inputs are priority decoded. This means that if two or more inputs are selected at once, only the highest priority message will be spoken, and no other message will be spoken until the highest priority line is released.

#### Construction:

There are only four components on this board so construction is very simple. First solder in the two wire links, then the six-way dip switch and socket for IC1. Fit the two four-way terminal blocks next.

J1, the 10-way header requires a bit more thought. If you wish to mount this board remotely, you should connect this header as usual and use two plugs and some ribbon cable to connect them. If you do this, make very sure you don't plug the cable in backwards as this will destroy IC1 and maybe the SSS.

If you wish to make the whole assembly a more compact unit, you can arrange it so you can simply plug the unit in on top of the SSS's 10-way plug. To do this mount the header on the **UNDER-SIDE** of the board by slotting it in from the component side (long bit first) until the plastic base hits the board. Then carefully solder it in place.

To make sure that you orient this board correctly, bear in mind that once in place it covers IC6 and IC7. Plugged in this way, the board should match up nicely with the edges of the main board.

Now, I hear you asking, are we supposed to plug two male plugs together? Well, it's done like this. Take the two 10-way sockets that you were going to use for the cable and look at the little metal bits. You are supposed to crimp the wires into these and plug them into the plastic socket carrier. Instead, take 10 of these and crimp them on to the long ends of the header on the expansion board. Align them so they all face the same way, and will plug into the plastic carrier correctly, then solder them in place so that they can't move about. Now, slide the plastic carrier over them until it snaps into place.

#### Operation:

Looking at the overlay diagram on the previous page you will see the SW1 is labelled XABCDE. X is not connected, A is the least significant address line and E is the most significant. You select the group of seven you wish to address here. For group one you switch only "A" on. Then seven messages in group one will be available priority decoded at J2 on the main speech board. Group seven is selected by switching "A", "B" and

"C" on. You can select up to 32 groups of seven, (groups 0 to 31) using this board, if you have a 27256 EPROM.

Remember that the inputs are active low, as before, so you have to connect them to ground to select them.

#### How it works:

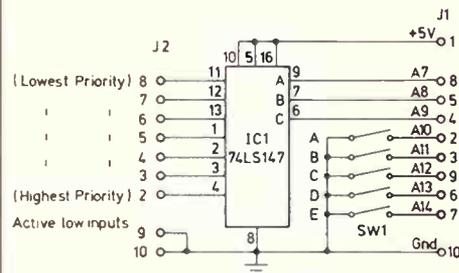
The operation of the circuit is simplified greatly by the use of IC1, 74LS147. This chip takes a one-of-eight input and priority encodes it into the binary that the SSS experts. A five-way DIP switch is connected to the upper five address lines and allows you to select which block of seven messages you will access.

Due to the unorthodox way in which the SSS takes its inputs, this circuit can access only seven of the possible eight messages in each block. If you use your own EPROM and wish to use this expansion board, then the first message area in every block (ie: 0-7f,400-47f,800-87f,c00-c7f,1000-107f,1400-147f,1800-187f,1c00-1c7f all address values in Hex), must be filled with c0 Hex, and cannot hold a message; no matter there's still 56 left if you're using a 2764.

The problem arises from the fact that the SSS acts on ANY input it receives. What this means is that as soon as you make a block selection on the DIP switches, it would try to speak the first message in that block.

#### Address Table:

X	A	B	C	D	E	Block
X	0	0	0	0	0	0
X	1	0	0	0	0	1
X	0	1	0	0	0	2
X	1	1	0	0	0	3
X	0	0	1	0	0	4
X	1	0	1	0	0	5
X	0	1	1	0	0	6
X	1	1	1	0	0	7



#### Parts list:

##### Semiconductors

IC1..... 74LS147 8 to 3 BCD encoder

##### Miscellaneous

J1..... 10 way header (2 \* 8-way headers Jaycar HM-3210)  
J2..... 2 \* 4-way terminal block (Jaycar HM-3207)  
SW1..... 1 \* 6-way Dip Switch (Altronics S-3055)

A 2764 with the messages described in this article already programmed is available for \$20 from David Thompson, P.O. Box 3587, Parramatta 2150.



# MEASURING OPTICAL FIBRES

J. Chipman

**M**ost articles devoted to fibre optic measurements tell only part of the story. There's more to the evaluation of optical system performance than testing fibre cables. Proper system evaluation required both subsystem and system level testing. So measurements can be divided into two types. One is optical subsystem and the other electrical system measurements.

Unless using the turnkey approach, the system installer and maintainer must be concerned with both measurement groups.

## Optical Subsystem Measurements

During the installation of an optical fibre system several optical subsystem measurements are usually performed. These measurements also apply to trouble-shooting an operational system. Measurements typically include most, if not all of the following:

- Cable Continuity
- Transmitted Optical Power
- Received Optical Power
- Fibre Cable Attenuation (Loss)
- OTDR Trace Recording
- Cable Bandwidth/Dispersion

The above measurements are listed in order of skill level, with the least skill required at the top. As an approximation, the order also conveys the cost and complexity of equipment required, again with the top being least.

Cable continuity requires little in the way of equipment or skill. Best applied to short fibre lengths and jumper (patch) cables, continuity can be assessed with only a white light source (perhaps even a torch) and the naked eye. A word of warning needs to be given here. Since there is always the possibility of viewing an active fibre (one with an operational LED or Laser light) direct viewing of any fibre end with the naked eye is not recom-

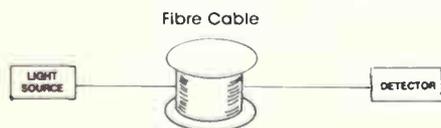


Figure 1 Optical Continuity

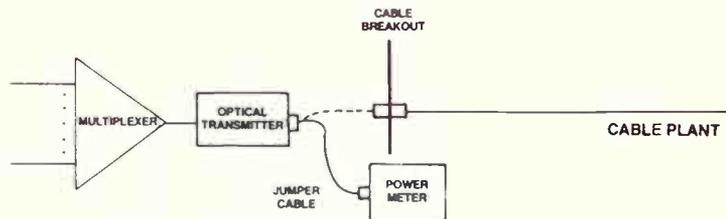


Figure 2 Transmitted Optical Power

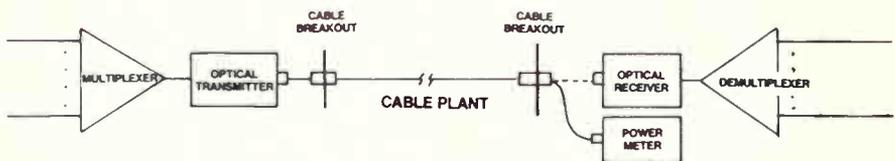


Figure 3 Received Optical Power

mended! An inexpensive light source and optical detector is more appropriate, as shown in figure 1.

Continuity provides a simple go-no go verification that the cable or jumper passes light. There is no attempt to assess the quality of the optical path. Therefore, neither the optical source or power meter need be stable or accurate to perform continuity measurements. The skill level is also minimum, requiring no judgement of cable quality.

Next down the list, transmitted optical power, requires additional skill and instrumentation. Requiring an Optical Power Meter of reasonable accuracy, precision, and resolution, transmitted optical power is measured in units of dBm or Watts. The more common being dBm, which is the optical power referenced to 1 milliwatt in a logarithmic scale. A reading of 0 dBm is 1 milliwatt, -10dBm is 100 micro Watts, -20 dBm is 10 microWatts, and so forth. Measuring the transmitted optical power is accomplished by simply connecting the power meter to an operating transmitter's output and reading the power meter's display as shown in figure 2.

Received optical power is similar to transmitted optical power except that the power meter is connected to the end of the fibre which normally connects to the

optical receiver as shown in figure 3. If the received optical power level is too low or too high for proper receiver operation, the system will not function correctly. If the power received is too high an optical pad (fixed attenuator) can be inserted in front of the receiver to limit received power. Too low requires a more sensitive receiver, lower loss or shorter cables, or higher transmitter power.

Accurately measuring a cable plant's attenuation requires the use of a Loss Set. A Loss Set consists of a highly Stable Optical Source and an Optical Power Meter. Referring to figure 4, first the power is measured on the power meter and stored as a reference. Then the source is connected to one end of the cable plant while the power meter is connected to the other end. By measuring the power received in reference to the stored power, the loss set can calculate and display the cable loss. Whether the source and power meter are separate or combined into one instrument is not relevant to the measurement principle. The choice remains a function of individual needs and preference. There are valid arguments in defense of either approach.

While loss can be measured using an operational system's transmitter and a power meter, the results obtained will be

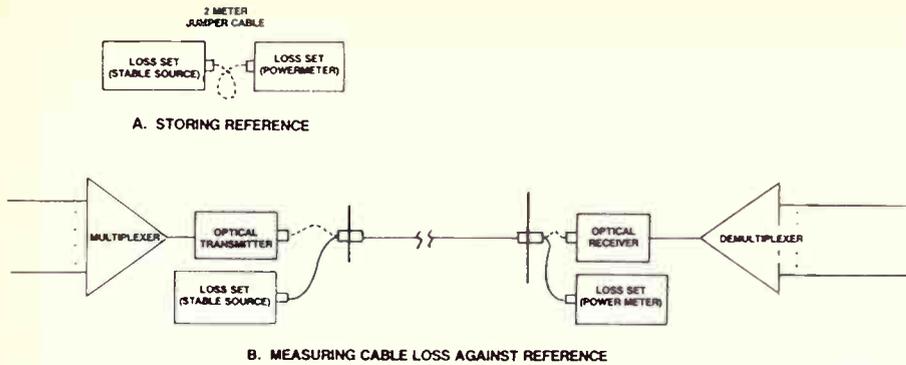


Figure 4 Loss Measurements on Cable

less accurate with lower measurement repeatability. Transmitters are designed for the emission of high power signals usually digital or FM analogue, not amplitude (light level) stability. One of the main reasons for measuring end-to-end cable plant loss should be for maintenance records, permitting the system maintainer to re-measure cables at a later date to uncover any degradation or potential problems. Measuring loss without a stable source will result in clouded remeasurement results and non-repeatability.

The skill level required for loss measurements increases slightly beyond transmitted (or received) optical power measurements. Test personnel now need to operate and understand two instrument functions. There is also the requirement to take additional care in equipment set-up to obtain accurate and repeatable measurements. Source launch conditions, wavelength, and type (LED or Laser) all combine to make (or break) loss measurement accuracy.

Optical Time Domain Reflectometers, better known as OTDRs, are used extensively by cable splicers for real-time splice loss measurements, and maintenance personnel for cable break location. OTDRs add a second dimension to Loss:Distance. By sending out a short optical pulse and measuring the elapsed time between pulse transmission and echo return detection, distance to the echo location can be calculated. Calculations can be performed

knowing the fibre characteristics and the speed of light.

Most OTDRs have an oscilloscope type of CRT display which provides a continuous trace of distance along a fibre cable verses optical loss. Figure 5 illustrates a typical OTDR trace. An advantage of an OTDR is its single-ended operation. Measurements can be made from one-end of the cable plant. The OTDR's advantage however, also works to its disadvantage. The fact that an OTDR sends light pulses down the fibre and back to its detector results in twice the attenuation seen by a loss set. Loss doubling, coupled with an OTDR's lower receiver sensitivity (compared to a loss set) significantly decreases the distance over which an OTDR is useful. On longer (or higher loss) cable plants, often the fibres must be measured from both ends to obtain a complete picture of the cable plant. Furthermore, OTDRs are designed primarily for the highest output pulse power obtainable along with distance resolution, not long-term amplitude stability.

Expenses and skills associated with OTDRs are at least a factor of two and three times greater than a comparable loss set respectively. An OTDR can be as complex to use as a good digital oscilloscope. And in a trend not unlike the history of oscilloscopes, OTDRs are moving towards higher complexity as additional features are incorporated. This is not to say that OTDRs are overkilled instruments. OTDR measurements are the only method of determining cable break locations. They are also the best measurement method for splicing fibres if their inherent distance limitations are not exceeded. However, OTDRs are no more the answer to optical measurements than oscilloscopes are to electrical measurements.

While the application of an OTDR for cable splicing and break location is common, an OTDR should also be used for an additional system measurement. This measurement is OTDR Trace Recording. OTDR trace recording is simply the written (plotted) record of each fibre within the system's total cable plant. A trace

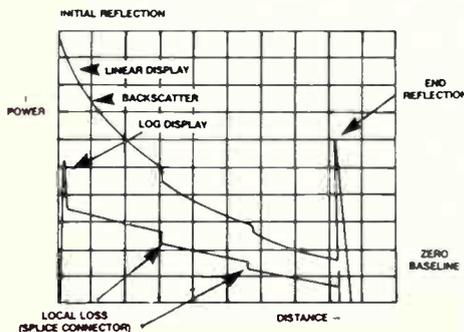


Figure 5 Typical OTDR Display

should also be taken in both directions (from opposite ends) for each fibre to uncover details often unseen in only one direction. The reason for trace recording is straightforward. If, at a later date, a particular fibre in the system's cable plant is questioned as a possible cause of some system problem, maintenance personnel can re-measure the suspect fibre and compare the new trace to the original recorded trace to uncover degradation or other cable problems.

Last on the list; costly, complex, and least used is cable Bandwidth and Dispersion. Bandwidth and Dispersion are mathematically interchangeable and provide a measure of the fibre cable's information transmission carrying capacity. On multimode fibres bandwidth is usually measured directly with a Bandwidth Test Set in MHz. On singlemode fibres having inherent bandwidths many magnitudes greater than multimode, dispersion measurements are the only realistic approach. Singlemode Dispersion Test Sets are becoming available which, in conjunction with complex calculations, can provide dispersion in ps/nm/km. Figure 6 illustrates

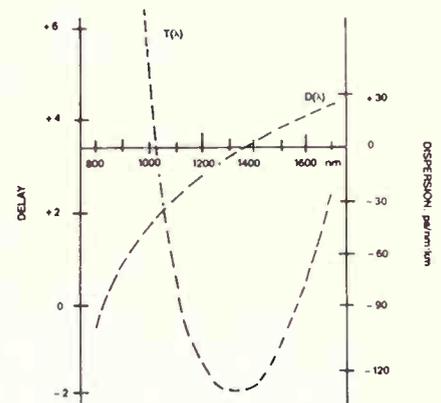


Figure 6 Time Delay and Dispersion

time delay measurements (dots) along with the resultant dispersion calculations. Figures 7 and 8 show typical measurement set-ups for bandwidth and dispersion measurements in the field, respectively. While the costs, skill levels, and complexity are great for bandwidth, they're far greater for singlemode fibre dispersion measurements.

Fortunately for most system planners, installers, and maintainers alike, bandwidth and dispersion measurements are not a necessity on today's systems. Few systems require actual measurements. For most systems, estimates are all that's required. In the years before singlemode fibre multimode fibres were pushed to their limits and bandwidth measurements became important. Then with the advent of singlemode fibre and its inherent bandwidth coupled with the use of the multimode for short distance, low speed sys-

## Measuring Fibres

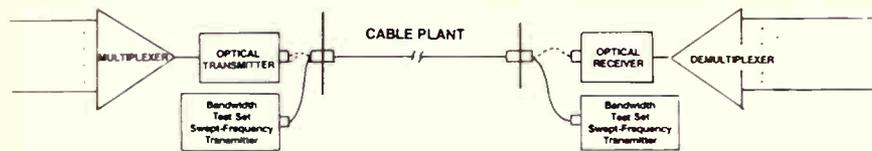


Figure 7 Bandwidth or Multimode Fibre

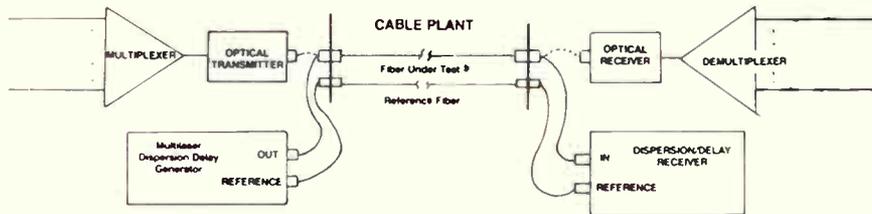


Figure 8 Dispersion on Singlemode Fibre

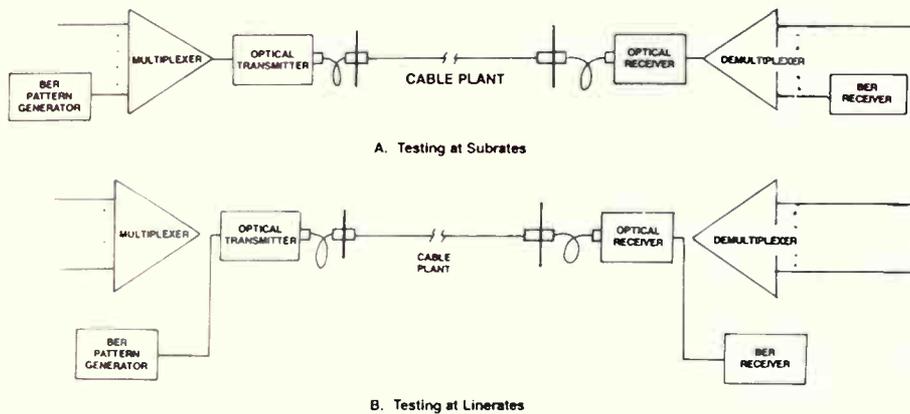


Figure 9 Bit Error-Rate Measurements

tems only, eliminated the measurement need on systems. However, with the trend toward multi-gigabit singlemode systems and 100 + Mbps multimode LAN systems these measurements may be brought back into the limelight.

### Electrical System Measurements

While optical measurements are important, they do not provide any measure of system performance. Electrical and electro-optical tests now come to the forefront. These tests measure not only the fibre transmission path but transmitters, receivers, multiplexers, demultiplexers, and electrical connections, as well. Ordered by importance, with the most important at the top, system measurements include:

- Optical Margin
- Bit-Error-Rate
- Eye Diagram
- Alarms & Redundancy Switchover
- Special System Features

Optical Margin measurements are the most useful to a system maintainer. Unfortunately, they are rarely performed and most likely understood less. Optical mar-

gin tests are really extensions of Bit-Error-Rate (BER) or Signal-To-Noise (S/N) measurements commonly performed on optical fibre systems. To understand margin, one needs to first understand BER (or S/N).

Bit-Error-Rate measurements are performed on a complete system, at either the line rate, (the data rate over the optical fibre) or at a sub-rate (on multiplexed systems), or both. A BER pattern generator is connected to one end of the system

while a BER receiver is connected to the other end. Figure 9 illustrates a typical system configuration for BER measurements.

Errors occurring along the transmission system are collected and displayed by the BER receiver. Bit-Error-Rate measurements provide the expected performance of an operational digital system. The error rate measured by the BER instrument will be statistically representative of the error performance when the system is operating. BER measurements are unique in that they are usually both the first and last measurement to be made on a digital optical fibre system. During the initial system installation and after a system is repaired, BER tests are the measurement which validates system performance. And when trouble is suspected, BER testing is first used to validate that suspicion.

Signal-To-Noise (S/N) or Carrier-To-Noise (C/N) measurements are similar to BER measurements in concept, but where BER is measured on the vastly more popular digital transmission systems, S/N or C/N is measured on analogue transmission systems. Using rf voltmeters, transmission measurement sets, or oscilloscopes, the signal (or carrier) amplitude is measured and compared to the background noise amplitude. The greater the S/N (or C/N) the greater the system performance.

Returning to the subject of Optical Margin, only one instrument is required in addition to the equipment used for BER (or S/N): a variable optical attenuator is inserted between the optical cable plant and the optical receiver. An Optical Margin is simply the level of optical power (in dB) received in excess of that which is required for proper system operation. While there is no standard defining "proper system operation" typical BER figures used in the industry are  $10^{-8}$  or  $10^{-9}$ .

Knowing the system's optical margin, the system maintainer can realistically project the effects of long-term optical degradations and repairs on system per-

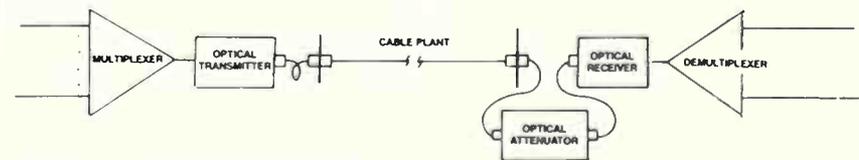


Figure 10 Optical Margin Measurement

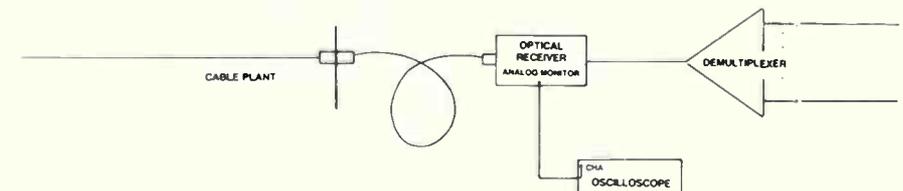
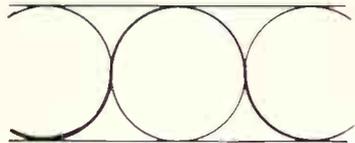
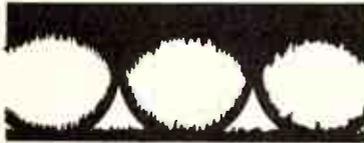


Figure 11 Eye Diagram Measurement



Good "Eye"



Degraded "Eye"

Figure 12 Examples of Eye Diagrams

formance. For example, if the margin on a particular system was found to be only 2 dB, the system maintainer has reason to be concerned. If the cable needs to be respliced, 1 dB of additional loss can be easily incurred, leaving only 1 dB. And 1 dB of LED or Laser degradation is also easy to come by, leaving the system on the brink on failure. On the other hand, too much margin may stress the optical receiver's front end, also resulting in poor performance. In this case, knowing the margin gives the maintainer (or installer) the information necessary to correctly pad (attenuate) the incoming optical signal to the receiver.

Further down the list are system alarms, redundancy switchover, and special features. Most optical fibre systems have some form of alarm indication and high speed telecommunication systems more often than not include automatic switchover capability to redundant or secondary circuits. Without proper testing, these features along with other specialised ones have unknown performance. When they become needed, will they work as designed or planned? Only proper testing will validate that they indeed work and at what point they become effective.

Testing and exercising these functions are best done with the same set-up used for Optical Margin. In fact, the best time to perform these tests is directly after the Optical Margin is measured. Once the amount of attenuation added to the system with the variable attenuator to obtain the margin, additional attenuation is inserted until the alarms and/or switchover occurs. Like Optical Margin, an accurate measurement of the added attenuation is made at the alarm/switchover point. The system maintainer then knows not only that the features will work, but at what level of system degradation did they become effective.

*J. Chipman is with the Intelco Corporation.*

*ETI would like to thank Mr Graham Sharp of Scientific Devices for assistance with this article.*

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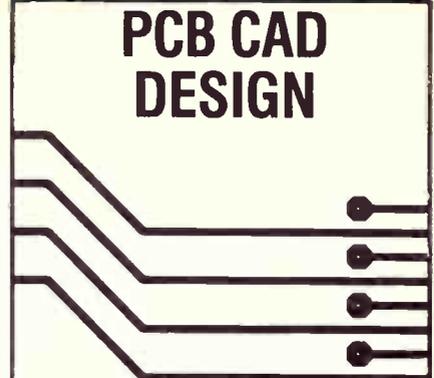
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The WRITER-1™ provides serial data input and output through its RS232 Port. Both downloading and uploading to a host computer are supported.



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## TECHNOLOGY AWARD UPDATE

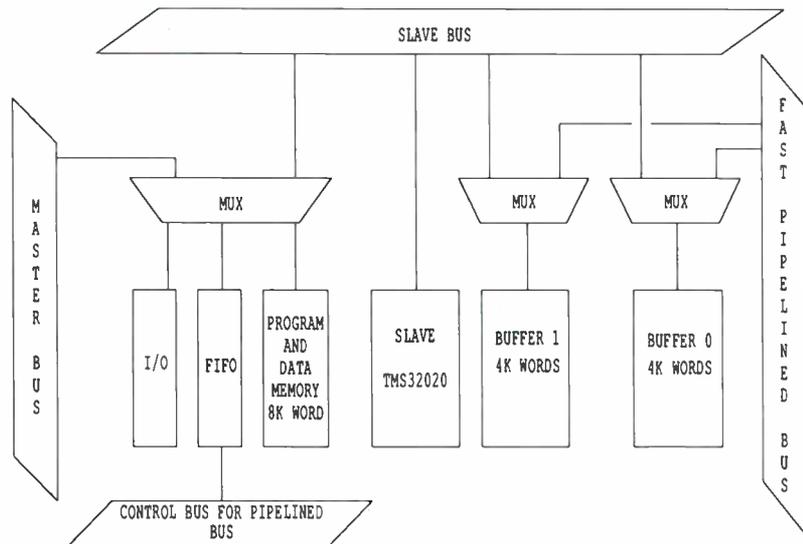
During 1987 Texas Instruments sponsored various final year electrical engineering projects in the fields of Digital Signal Processing, Local Area Networks, and Parallel Processing.

Parallel Processing systems are called "parallel" because they incorporate an architecture which allows processing of multiple data streams at the same time. There are two main architectures used called SIMD and MIMD. In an SIMD system (Single Instruction Multiple Data) a group of parallel processors will each operate on different pieces of data, however, they will all be performing the same instruction. Alternatively, in MIMD systems (Multiple Instruction Multiple Data) the parallel processors are not only performing on different pieces of data, they are also performing different instructions. In the future we can expect to see more and more computers based on either SIMD or MIMD architectures because much higher computing speeds are required for the large computational demands of applications such as image processing.

In this report we examine some of the issues in an MIMD system which uses one TMS32020 Digital Signal Processor as a master processor, and eight TMS32020's as slave processors, for high speed image processing.

### PRINCIPLE OF OPERATION

Once the host computer has downloaded program code to the master TMS32020, it releases the master to begin processing. The first task that the master performs is to initialise the interrupt controllers and its own hardware timer and registers. Images are downloaded by the host into the master data memory while the master loads the slave's program memory. If each processing element (a TMS32020) has the same program, the master can write code simultaneously to all the TMS32020s. Once the code is in slave memory, the slaves are released and begin processing the data.



**PROJECT: TMS32020-based MIMD Parallel Image Processor**  
**STUDENT: Murray Macpherson**  
**SUPERVISOR: Dr. S. W. Chan, University of Newcastle**

A typical sequence of events for processing an image is as follows, assuming that the system contains two image memory blocks and at least two processing elements (PEs):

- 1) The master sets a flag in each PE data memory indicating that no image is in memory. It then interrupts the host requesting an image be downloaded to the image memory.
- 2) The master also informs the PEs the address location of the image being placed in main memory by the host, and partitions each PE to process a portion of the image.
- 3) The PEs wait for a valid image. When the host has downloaded an image, it interrupts the master which resets the flag in PE data memory allowing the PEs to commence.
- 4) All PEs requiring image data send an interrupt request to the pipelined bus controller. Each interrupt request is

processed in turn using a rotating priority scheme and the pipelined bus transfers data to each PE.

- 5) Simultaneously, the master again interrupts the host requesting a second image be placed in another memory block ahead of time.
- 6) When the pipelined bus has completed a transfer, it interrupts the PE and informs it that the data is valid.
- 7) Upon receipt of this interrupt, the PE downloads the data from its buffer into on-chip RAM, processes the data, and returns the results back to the same buffer. The FIFO is again loaded and another interrupt is sent to the pipelined bus requesting that the processed data be uploaded back to image memory and new data be placed in the new empty buffer. Without waiting, the PE then immediately begins processing the data held in its other buffer.



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## Wise Advice

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## Pessimism

An optimist believes we live in the best of all possible worlds — a pessimist fears this is true.

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Nothing is ever so bad that it can't get worse.

Blessed is he who expects nothing, for he shall not be disappointed.

## The Automotive Laws

1. Nothing minor ever happens to a car at the weekend.
2. Nothing minor *ever* happens to a car.

## At Your Own Risk

In the new England Journal of Medicine recently, Neil Shear, a doctor in Toronto, describes the case of a 60-year-old man

who turned up in his surgery complaining of an ache in his calf. He described the pain as mild, deep in the muscle and dull.

The doctor conducted a thorough examination but admitted to being rather nonplussed. He sent the patient away with the instruction to take some pain killers and to return if his leg got worse.

Two nights later, the source of the pain was revealed. The patient awoke, presumably more quickly than usual, with a sharp pain in his calf. The pain had been caused by a kick from his wife. "Don't kick me there," the patient protested, "that's where my leg hurts."

"You were snoring again," his wife replied, "that's where I always kick you to stop it."

Happily, the wife agreed to stop kicking the husband and, shortly afterwards, the pain disappeared.

## Christmas cheer

This year's festive season produced its usual crop of strange gifts.

For astronomers, there was the "High-Lite" binocular support from Celestial Innovations in Arizona. A gantry device, worn round the neck and supported on

the chest, the High-Lite points your binoculars towards the night sky. By supporting the binoculars firmly, it leaves your arms free so that you can gesticulate wildly if you see something new. A must for ET-spotters everywhere.

For naturalists, how about the Lastohide, a portable hide available from Kennett Engineering in the UK. Consisting, essentially, of a broad-brimmed hat with a curtain that reaches to the ground, the hide will fold away into a small zipped bag, so you can merge into the background anywhere. Available in two fetching shades of camouflage — one for northern forests and tropical jungles, the other for hotter, drier climes — it weighs less than 500 grams.

For physicists, meanwhile, Technical Insights, of California, has been quick to latch on to super-conductivity. In what must be one of the first commercial applications of super-conductors, the firm has come up with Superconductivity: a Guide to the Corporate Players, a scorecard that allows you to keep track of who's doing what in the field. The guide lists 42 companies and costs just \$295 (\$330 outside the US).



Oh look Mum, there's Bambi!

# DATASAT

and

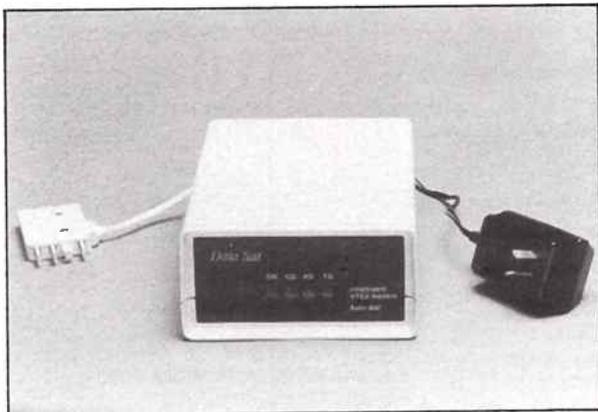


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