Electronics Today

INTERNATIONAL

INCLUDING SOUND INSIGHTS

eti

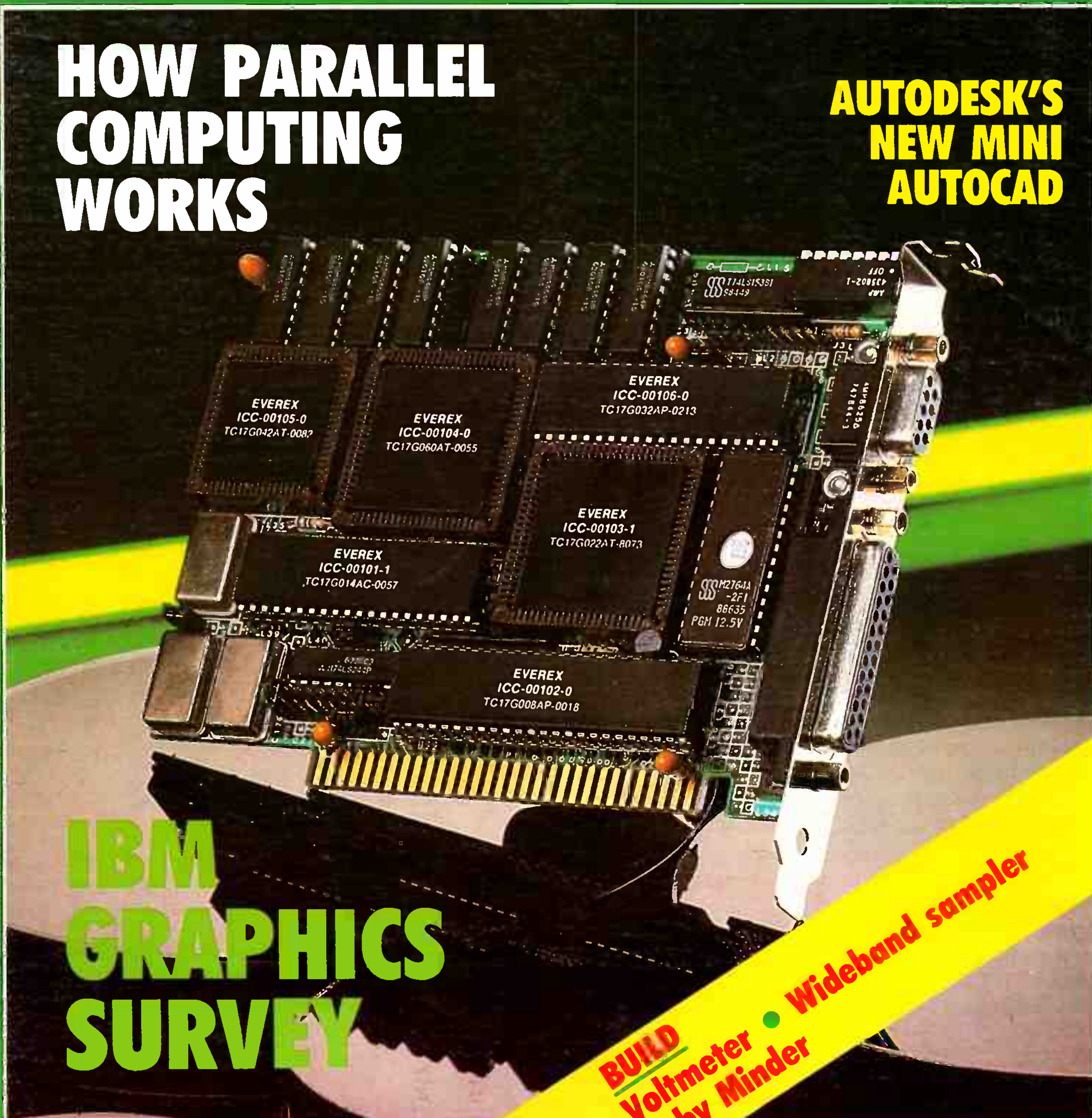
WIN A MODEM

APRIL 1988 $3.50
NZ $4.50 (inc. GST)

INSIDE WOLLONGONG'S NEW TECHNOLOGY CENTRE

HOW PARALLEL COMPUTING WORKS

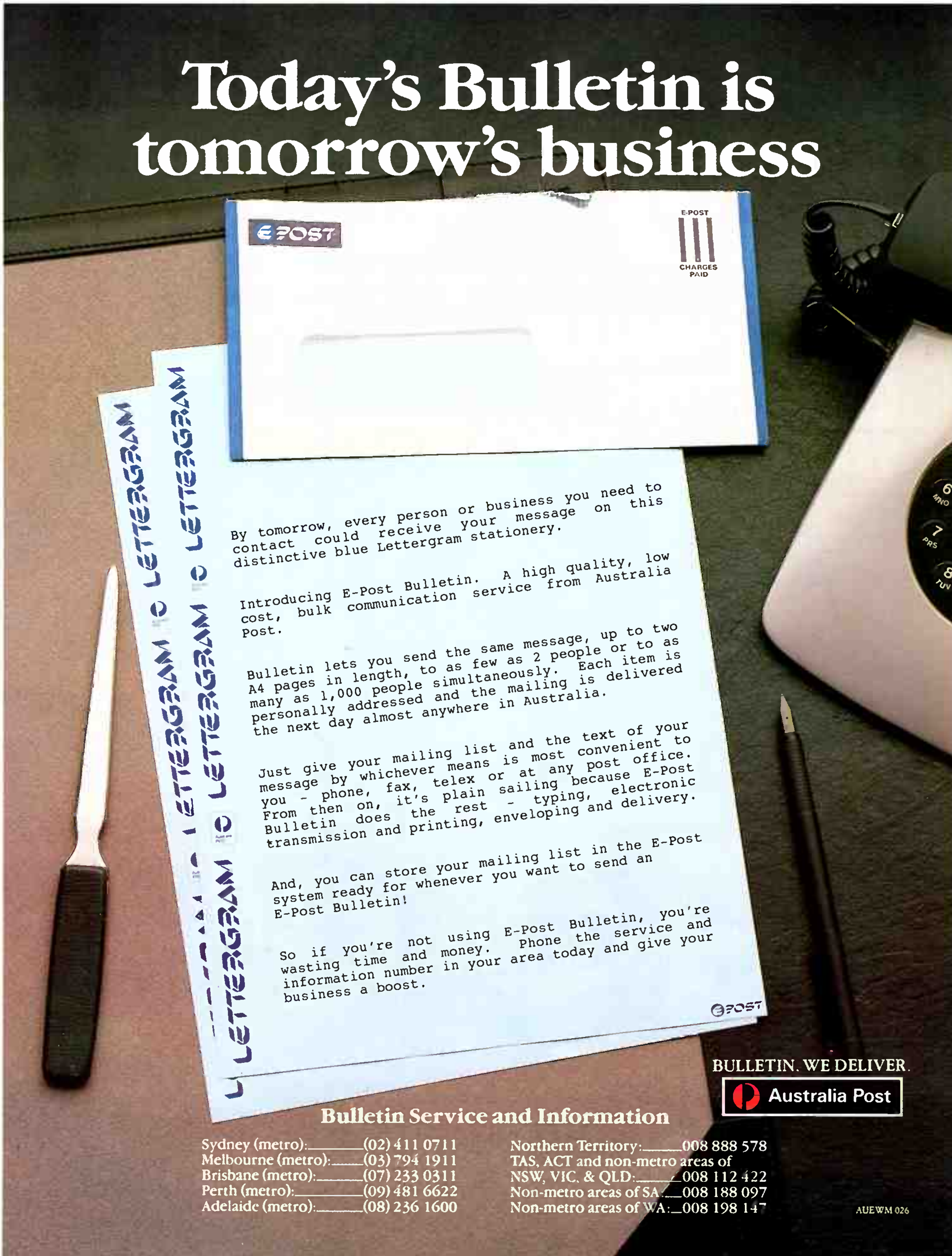
AUTODESK'S NEW MINI AUTOCAD



IBM GRAPHICS SURVEY

BUILD
- Voltmeter
- Baby Minder
- Wideband sampler

Registered by Australia Post. Publication No. [illegible]


Today's Bulletin is tomorrow's business
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CHARGES PAID
LETTERGRAM
By tomorrow, every person or business you need to contact could receive your message on this distinctive blue Lettergram stationery.
Introducing E-Post Bulletin. A high quality, low cost, bulk communication service from Australia Post.
Bulletin lets you send the same message, up to two A4 pages in length, to as few as 2 people or to as many as 1,000 people simultaneously. Each item is personally addressed and the mailing is delivered the next day almost anywhere in Australia.
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AUEWM 026

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COVER: Card from Everex, photo Greg McBean.

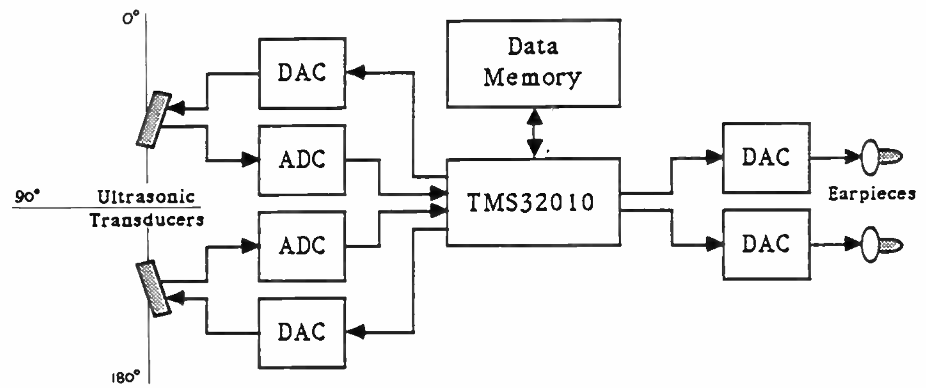
TEXAS INSTRUMENTS

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.

Since the conception of high speed RISC (Reduced Instruction Set Computer) processors in the early 80's, the previously theoretical field of Digital Signal Processing has emerged into a practical and realtime discipline. Simply put, DSP involves the processing of analog signals that have been sampled and are in digital form. In this form, numerical algorithms can be performed on the sampled data that are difficult or impossible to perform whilst the signals are in an analog form.

In this report we examine the issues involved in the design of an electronic aid for the blind using DSP techniques executed by the TMS32010. The design is based on an existing analogue aid, but with improved performance due to the flexibility of Digital Signal Processing.



PROJECT: TMS32010 based sonar ranging aid for the blind.
STUDENT: Jon Rowlands.
SUPERVISOR: Glyn Adams.

THE DESIGN

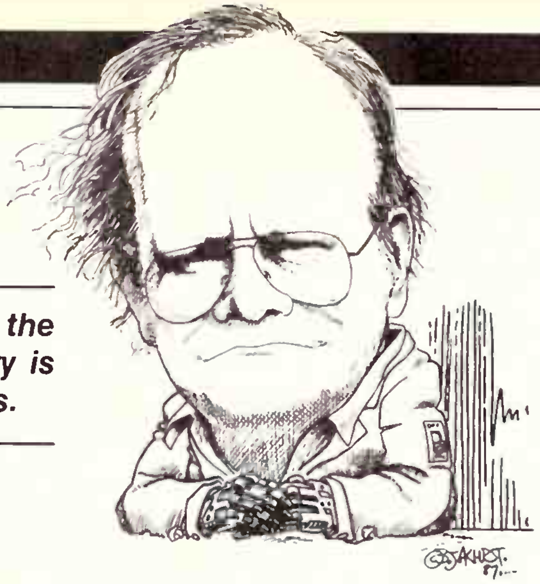
The principal area of this design is the processing of received signals resulting from a known transmitted pulse being reflected from a certain scene, that scene consisting of the objects that the blind person cannot see. Certain attributes of the scene such as ranging and 2D direction of objects is extracted from the reflected wave. This is achieved by the bi-directionarl operation of two sonar transducers, the output of which are digitised and fed to the TMS32010. The sonar signal sent and received is monitored by the TMS32010 in order to be able to perform the necessary DSP algorithms. The processing results in an audible sound which varies as objects in a subject's 'visible' path are encountered.

THE DSP ISSUES

When a transmitted signal reflects off an object in the direction of the transducers, provided the object is between 0 and 180 degrees, and not equal to 90, there will always be a difference in the time that the reflected signal hits both transducers. This difference being also a function of the transducer separation, determines the direction of the object with respect to the subject. This time is monitored by the DSP and an audible sound is channelled to the ears of the subject to give the spatial information necessary to sense direction.

The ranging of an object is dependent upon the time delay between the reflected and transmitted pulses. Due to the reflection and distance travelled in the medium, a delay can be gauged to the distance from the object. Normally, this is done by using a matched filter at the receiver which convolutes the transmitted signal with the received. However, reflected signals may overlap causing the deletion of some echoes in the convolution process, in which case a de-convolution method has to be used. This involves an iterative process that estimates the scene as a conceptual filter by using the received pulses, the transmitted pulses, and negating the inherent noise. The delay information can be extracted from the scene filter, however, there is more processing and buffering of reflected pulses needed than that of matched filter detection. Once the range has been detected the result is routed to the subject's ears in the form of varying volumes of sound.

One final effect to overcome is that of the Doppler Effect. The signal being transmitted (39 KHz) is Frequency Modulated (FM) at a depth of approximately 4 per cent. When either the subject and/or their scene moves, an unmodulated carrier would experience frequency shifting and would therefore be hard to detect by convolution methods. Use of an FM carrier alleviates this problem and facilitates detection.



> *The truth is that the loss of an industry is just that; a loss.*

The models flaunting their bodystockings down the Opera House catwalk were advertising more than the skills of the frock floggers at the great bicentennial fashion show in Sydney recently. The technologists of wool, who can turn the stuff of my mum's old cardy into contour-hugging designer-wear, deserved, and got, the accolades of the crowd.

The wool industry, as well it might, used the occasion to give new expression to a hoary old Australian argument: concentrate on primary products, and, adding value to those products through technology, we will be much better off than if we try to compete with the world by making manufactured products, especially the types of products that come from the electronics industry.

It's an argument that could be echoed by a number of other industries that earn Australia millions of dollars overseas: steel, aluminium, timber. They are all industries where Australia has a comparative advantage with respect to most of the other countries of the world, especially the countries of the Pacific rim.

So should we all give up on modems and robotics and radio telescopes and go watch the rabbits multiply west of Wilcannia?

The answer, of course, is no. The argument of comparative advantage was first ennunciated by Adam Smith almost two hundred years ago as one of the foundation platforms of his theory of capital. It was an attractive idea then, just as it is now, but since that time, there have been precious few examples of healthy economies where it has been found operating. Economics, unlike electronics, is not an exact science. It is quite unnecessary for a theory to actually account for the facts.

The truth is that the loss of an industry is just that; a loss. It is a sign of an economy in decline. It did not make the Australian economy stronger when the electronic component industry was snuffed out or when domestic electronic manufacture went offshore. We all became losers because money which once stayed in Australia is now exported to fill our needs.

There are, of course, plenty of economies around the world that do one thing, or a small range of things, and what's more, do them rather well. Fijians, for instance, make great sugar, and Zambians can rip copper out of the ground faster than anyone else, but neither is an example of a healthy economy. Both suffer from the vagaries of world demand for their product. Both have trouble building an educated workforce that can see advantages in other forms of endeavour. Both, to quote Mr Paul Keating, are 'banana republics', and neither is an example Australians would want to copy.

The thing that strikes one about the world's successful economies is that they do everything well. Country-folk might not like to hear it, but US and European farmers are at least as efficient as Australian ones. In addition their mining, fishing, heavy engineering, tourism, fashion and electronics industries are also large and profitable.

In economics, as in everything else, variety is the spice of life.

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SUPERB VIFA/EA 60 - 60 SPEAKER KIT!

The Vifa EA 60 - 60 loudspeaker kit has been designed to completely out perform any similarly priced speakers. This is a 2-way design incorporating drivers which give a deeper, more natural bass response and 19mm soft-dome ferro fluid cooled tweeters which provide clear uncoloured sound reproduction.

These Vifa drivers are identical to the ones used in such fine speakers as Mission, Rogers, Bang & Olufsen, Monitor Audio and Haybrook just to name a few. Some of which cost well over $1,000 a pair!

The dividing network is of the highest quality and produce no inherent sound characteristics of their own, they simply act as passive devices which accurately distribute the frequency range between both drivers in each speaker.

The fully enclosed acoustic suspension cabinets are easily assembled. All you need are normal household tools and a couple of hours and you've built yourself the finest pair of speakers in their class!

D19 TWEETER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 2.5 - 20KHz
Free Air Resonance: 1,700Hz
Sensitivity 1W at 1m: 89dB
Nominal Power: 80 Watts (fo 5,000Hz 12dB oct)
Voice Coil Diameter: 19mm
Voice Coil Resistance: 6.2 ohms
Moving Mass: 0.2 grams
Weight: 0.28kg
Cat C10301 **$38**

C20 WOOFER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 35 - 6,000Hz
Resonance Frequency: 39Hz
Sensitivity 1W at 1m: 90dB
Nominal Power: 50 Watts (12dB oct)
Voice Coil Diameter: 25mm
Voice Coil Resistance: 5.5 ohms
Moving Mass: 15 grams
Cat C10322 **$89**

Cat K86092 (speakers only) **$379**
Cat K86091 (complete kit) **$449**

WALL MOUNTING SPEAKER HOLDERS

Mount your speakers at ear level on your wall!
Features:
- Holds speakers up to 260mm deep
- Left Right adjustment
- Up Down adjustment
- Includes mounting screws
- Nipping-screw pins hold speakers firmly in place
- Installation instructions

Cat.H28630
Normally $89.95
SPECIAL, $59.95

CRYSTAL LOCKED WIRELESS MICROPHONE AND RECIEVER

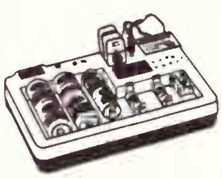
MICROPHONE SPECIFICATIONS:
Transmitting Frequency: 37.1MHz
Transmitting System: crystal oscillation
Microphone: Electret condenser
Power Supply: 9V battery
Range: 300 feet in open field
Dimensions: 185 x 27 x 38mm
Weight: 160 grams

RECIEVER SPECIFICATIONS:
Recieving Freq: 37.1MHz
Output Level: 30mV (maximum)
Recieving System: Super heterodyne crystal oscillation
Power Supply: 9V Battery or 9V DC power adapter
Volume control
Tuning LED
Dimensions: 115 x 32 x 44mm
Weight: 220 grams
Cat A10452 R.R.P. $113
Our price, $99

NICADS!

Save a fortune on expensive throw away batteries with these quality Nicads and Rechargers!

Size	Desc.	1-9	10+	100+
AA	450 mA H	$2.95	$2.75	$2.50
C	1.2 A H	$9.95	$9.50	$8.95
D	1.2 A H	$9.95	$9.50	$8.95



DELUXE UNIVERSAL BATTERY CHARGER AND TESTER

Save money on expensive batteries with this universal battery charger. Features include meter tester and provisions for up to 8 pieces of any size (D, C, AA or AAA type batteries) at once, plus positions for a button and cell battery. Two times 9V, and one times N type batteries.
Recharging lead with alligator clips, 9V clip and 4-way universal. Select currents from 2.5-3V 150mA, 1.2-1.5V 80mA, 1.2-1.5V 25mA, 6-9V 14mA, 12V 50mA. Includes detailed instructions.
Cat M23535 **$49.95**

SUPER DELUXE BATTERY CHARGER

- Charges from 1 to 10 D, C, AA, AAA, N and up to 3 x 9V batteries at the same time
- Dual colour LED in first three compartments to designate 1.5V or 9V
- 240V AC 50Hz
- Approval No. N10637

Cat M23525 **$59.95**

10 TURN WIRE WOUND POTENTIOMETER

Spectrol Model 534
1/4" shaft.
Equiv. Bourns 3540S, Beckman 7256.
Dials to suit 16-1.11, 18-1.11, 21-1.11

R14050	50R	R14100	5K
R14055	100R	R14110	10K
R14060	200R	R14120	20K
R14070	500R	R14130	50K
R14080	1K	R14140	100K
R14090	2K		

1-9 **$9.95** 10+ **$9.50**

PUSH BUTTON DIALLERS

Tired of old fashion dialling and re-dialling engaged numbers? These convenient push button diallers include last number redial (up to 16 digits) and instructions for an easy changeover.
Cat A12030 Normally $19.95
SPECIAL, ONLY $14.95
(Note: Not Telecom approved)

OMNI-DIRECTIONAL WIRELESS MICROPHONE

Tuneable: 92 - 104MHz
Freq. Response: 50 - 15kHz
Range: Over 300 feet in open field
Modulation: FM
Power Source: 9V Battery
Type: Electret Condenser
Dimensions: 185 x 27 x 38mm
Weight: 160 grams
Cat A10450 **$19.95**

DB25 CONNECTOR SPECIALS!

P10884	DE9P R A Plug	$3.65
P10885	DE9S R A Skt	$4.25
P10890	DA15P Male	$2.10
P10891	DA15S Female	$2.25
P10892	DA15C Cover	$1.25
P10894	DA15P R A Plug	$4.25
P10895	DA15S R A Skt	$5.00
P10900	DB25P Male	$1.00
P10901	DB25S Female	$1.20
P10902	DB25C Cover	$1.25
P10904	DB25P R A Plug	$4.50
P10905	DB25S R A Skt	$5.95

CANNON TYPE CONNECTORS

1-9 10+
P10960 3 PIN LINE MALE
$3.90 .... **$3.50**
P10962 3 PIN CHASIS MALE
$3.00 .... **$2.50**
P10964 3 PIN LINE FEMALE
$4.50 .... **$3.90**
P10966 3 PIN CHASIS FEMALE
$4.95 .... **$3.95**

ULTRASONIC TRANSDUCERS

Designed to transmit at 40kHz (L19990) and receive at 40kHz (L19991) with up to 20V I.P on the transmitter. These units can't be heard and so are ideal for TV remote controls, water level detectors, burglar alarms, motion detectors and information carriers as they can be either pulsed or used in the continuous wave mode.
Full specifications below for design purposes.
Maximum Input Voltage: 20V rms
Centre Frequency (kHz): 40 ± 1.0
Sound Pressure Level 10V RMS 110dB min
Sensitivity (dB v ubar) min 65 min
Bandwidth (kHz):
Transmit 4.0 (at 100dB)
Receiver 5.0 (at 73dB)
Impedance
Transmit 500
Receiver 5000
Cat L19990 (Transmitter) **$4.75**
Cat L19991 (Receiver) **$4.75**

CPF CONTINUOUS POWER FILTER SPIKE ARRESTOR

The Fortron CPF Filtered Electronic Spike Protector provides a protective electronic barrier for microcomputers, printers, telephone systems and modems, electronic typewriters, audio and stereo systems and other sensitive electronic equipment.

The CPF provides protection from dangerous electrical spikes that can cause anything from obvious damage (like immediate equipment failure) to less obvious harm that can drastically shorten a system's life.

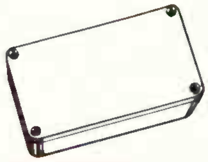
CPF's superior circuitry design and semi conductor technology responds instantly to any potentially damaging over-voltage, ensuring safe trouble free operation.

Additionally, CPF's filtering capability helps eliminate troublesome and annoying interference, general hash created by small motors, fluorescent lamps, and the like that threaten the performance and shorten equipment life of unprotected electronic components.

SPECIFICATIONS:
Electrical rating: 220-260 volts (AC) 50Hz 10 Amp
Spike/RFI Protection: 4,500 amps for 20m/second pulses
Maximum clamping voltage: 275V differential mode
Cat.X10088 .... **$69.95**

2¼" MINI SPEAKERS (57mm)

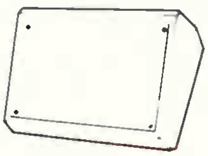
Cat.No.	1-9	10+
C10610	$1.95	$1.75



DIECAST BOXES

Diecast boxes are excellent for RF shielding, and strength. Screws are provided with each box.

H11451	100 x 50 x 25mm	$ 5.95
H11452	110 x 60 x 30mm	$ 6.50
H11453	120 x 65 x 40mm	$ 6.95
H11461	120 x 94 x 53mm	$11.50
H11462	188 x 120 x 78mm	$13.50
H11464	188 x 188 x 64mm	$29.50



SLOPING FRONT INSTRUMENT CASE

Plastic with metal front panel available in two sizes.
H10450 190 x 120mm **$12.95**
H10455 265 x 185mm **$21.95**
measurements are approximate only

ECONOMY 19" RACK CASE

Save with this quality rack mount case complete with vents, handles and assembly screws. Tremendous value!
Dimensions: 480 x 134 x 250mm
Cat H10415 **$44.95**

QUALITY 3mm LEDS

Cat. No. Col.	1-9	10+	100+
Z10140 Red	$0.15	$0.12	$0.10
Z10141 Grn	$0.20	$0.15	$0.12
Z10143 Ylw	$0.20	$0.15	$0.12
Z10145 Ora	$0.20	$0.15	$0.12

QUALITY 5mm LEDS

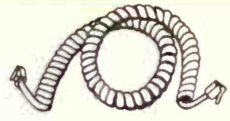
Cat. No. Col.	1-9	10+	100+
Z10150 Red	$0.10	$0.09	$0.08
Z10151 Grn	$0.15	$0.12	$0.10
Z10152 Ylw	$0.15	$0.12	$0.10

VEROBOARD SPECIALS

VERO 21070H
0.1" pitch strip board
Size 2.5 x 3.75 inches
H21070 Normally $7.50
SPECIAL, $4.95

VERO 21000F
0.1" pitch strip board
Size 3.75 x 17.9 inches
H21000 Normally $25.00
SPECIAL, $17.95

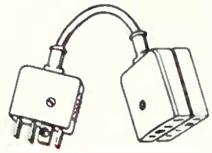
VERO 21012H
DIP Bread board. The design of this board is similar to that of the plug-in range of DIP Boards, except that it is not provided with gold plated contacts. They therefore offer a cost saving in those experimental applications where a plug in facility is not required. In place of contacts, individual mounting pads for terminal pins are provided.
Matrix 2.54 x 2.54mm
Hole Diameter 1.02mm approx
H21012 Normally $27.95
SPECIAL, $17.95



TELEPHONE CURL CORD

- U.S. plug to U.S. plug
- Replacement hand set cord
- Length 4.5 metres

Cat Y16023 **$7.95**



TELECOMMUNICATION PLUG TO 2 SOCKETS.

Ideal for modem connections
Cat Y16014 **$12.95**

TV INTERFERENCE FILTER

Cuts CB/Ham signals interference
Cat L11048 **$5.95**

UTILITY BOXES

Plastic boxes with aluminium tops and available in four sizes. Very popular for projects and very ecconomical!

H10101	150x90x50mm	$ 3.25
H10102	195x113x60mm	$ 4.50
H10103	130x68x41mm	$ 2.75
H10105	83x54x28mm	$ 1.95
H10110	120x65x38mm	$ 2.95
H10112	120x65x38mm	$ 2.95

(Metal top)

ECONOMY TRANSFORMERS

1-9 10+
2155 240V 6-15V 1A
Cat M12155 **$9.95** **$8.95**
2156 240V 6-15V 2A
Cat M12156 **$14.95** **$13.95**
2840 240V 9V CT
Cat M12840 **$5.95** **$4.95**
2851 240V 12-6V CT 150mA
Cat M12851 **$5.95** **$5.50**
2860 240V 15V CT 250mA
Cat M12860 **$5.95** **$4.95**
6672 240V 15-30V 1A tapped
Cat M16672 **$14.95** **$13.95**

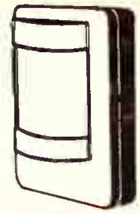
10W HORN SPEAKERS

White durable plastic. 8 ohms.
Cat C12010 Normally $11.95
SPECIAL, ONLY $9.95

BIG MOUTH CAR ALARM

FEATURES.....
- Easy installation
- Automatic on/off
- Loud alarm signal
- Auto reset
- Low Price!

SPECIFICATIONS:
Power: DC 12V battery
Current Consumption: 10mA at 12V DC
Dimensions: 139 x 165 x 136mm
Exit Delay: 60 seconds approx
Entry Delay: 12 seconds approx
Auto reset: 90 Seconds approx
S15048 .... **$39.95**



PASSIVE INFRA-RED DETECTOR (WP-800)

FEATURES:
- Walk test LED indicator
- Wall/corner/ceiling mount
- Micro switch tamper proof protection
- 24 detection beams in 3 different ranges
- N.C. silent S.P.S.T. dry relay contact output
- Alarm auto reset approximately 3 seconds after triggered
- Superior RFI immunity protection
- Extremely low power consumption
- Adjustable mounting bracket
- Easy installation, easy adjustment
- Dual element, low noise, high signal to noise ratio pyroelectric
- Detection degree indicator
- D.C. 8-16V power operating

S15079 .... **$89.95**

DIODE SPECIALS

We have millions of diodes in stock!

1-99 100+ 1000+
IN4148 Small signal Cat Z10135
3c **2½c** **2c**
IN4004 400V 1A Cat Z10107
4c **3½c** **3c**

STEREO WIRELESS TRANSMITTER

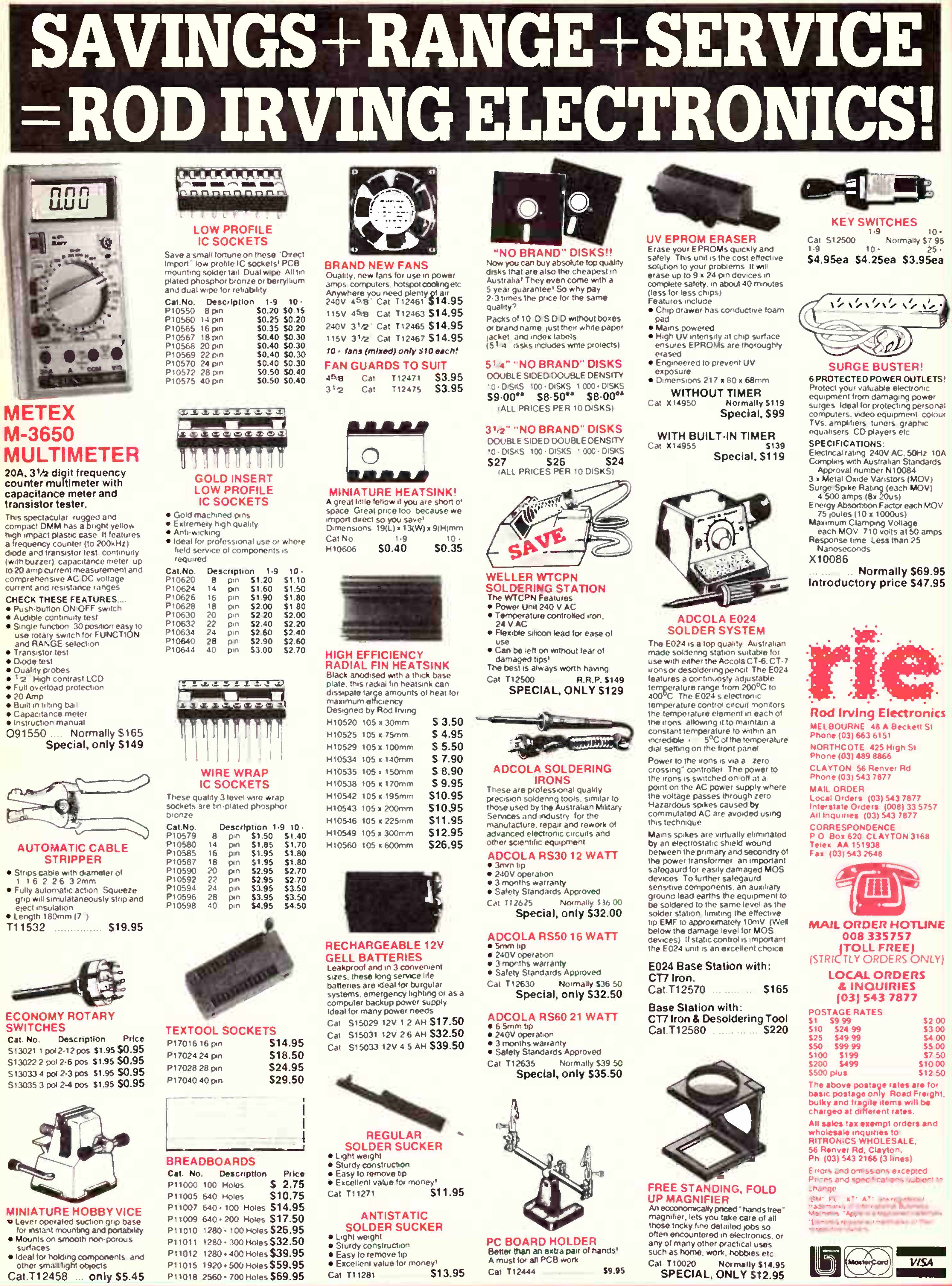
This unit was developed to allow portable compact disc players to be used in cars by transmitting the headphone output signal directly in to your stereo FM car radio. It will also transmit any mono/stereo signal from any headphone output to any FM receiver.

SPECIFICATIONS:
- Input: 3.5mm stereo phone plug. Impedance 32 ohm
- Mono/stereo switch has plug mounting clip
- FM Transmission approx 90-35MHz (Tuneable 89-91MHz)
- Range 15 metres (below 15mV/m at 100 metres)
- Power 1.5V AAA size batteries (100 hours continuous use)
- Size 72 x 38 x 21mm

A16100 .... **$69.95**

VIDEO AUDIO TRANSMITTER

A small compact unit that allows transmission of video and audio signals (RF) to any TV set or VCR within a range of 30 metres (100') simply by tuning in on Channel 11. Can be used as a transmitter for a video camera. With power on LED on/off switch, audio and video leads and supplied with an AC adaptor.
Transmission: VHF channel 11 (PAL)
Video Input: 75 ohms, 1V p-p
Audio Input: 600 ohms
Output Control: Audio-video fine adjustment
Power Sources: 9V battery or power adaptor
Accessories: RCA to RCA audio lead, RCA to BNC video lead
Size: 70(W) x 85(D) x 28(H)mm
Weight: 170 grams
A16150 .... **$69.95**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METEX M-3650 MULTIMETER
20A, 3½ digit frequency counter multimeter with capacitance meter and transistor tester.
This spectacular rugged and compact DMM has a bright yellow high impact plastic case. It features a frequency counter (to 200kHz) diode and transistor test, continuity (with buzzer) capacitance meter up to 20 amp current measurement and comprehensive AC DC voltage current and resistance ranges
CHECK THESE FEATURES....
• Push-button ON/OFF switch
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• Single function 30 position easy to use rotary switch for FUNCTION and RANGE selection
• Transistor test
• Diode test
• Quality probes
• ½ High contrast LCD
• Full overload protection
• 20 Amp
• Built in tilting bail
• Capacitance meter
• Instruction manual
Q91550 ..... Normally $165
Special, only $149
LOW PROFILE IC SOCKETS
Save a small fortune on these "Direct Import" low profile IC sockets! PCB mounting solder tail. Dual wipe. All tin plated phosphor bronze or berryllium and dual wipe for reliability
Cat.No. Description 1-9 10+
P10550 8 pin $0.20 $0.15
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GOLD INSERT LOW PROFILE IC SOCKETS
• Gold machined pins
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P10628 18 pin $2.00 $1.80
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P10632 22 pin $2.40 $2.20
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These quality 3 level wire wrap sockets are tin-plated phosphor bronze
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P10592 22 pin $2.95 $2.70
P10594 24 pin $3.95 $3.50
P10596 28 pin $3.95 $3.50
P10598 40 pin $4.95 $4.50
AUTOMATIC CABLE STRIPPER
• Strips cable with diameter of 1 1.6 2 2.6 3.2mm
• Fully automatic action. Squeeze grip will simultaneously strip and eject insulation
• Length 180mm (7")
T11532 .... $19.95
ECONOMY ROTARY SWITCHES
Cat. No. Description Price
S13021 1 pol 2-12 pos $1.95 $0.95
S13022 2 pol 2-6 pos $1.95 $0.95
S13033 4 pol 2-3 pos $1.95 $0.95
S13035 3 pol 2-4 pos $1.95 $0.95
TEXTOOL SOCKETS
P17016 16 pin $14.95
P17024 24 pin $18.50
P17028 28 pin $24.95
P17040 40 pin $29.50
MINIATURE HOBBY VICE
• Lever operated suction grip base for instant mounting and portability
• Mounts on smooth non-porous surfaces
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P11000 100 Holes $ 2.75
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P11012 1280 + 400 Holes $39.95
P11015 1920 + 500 Holes $59.95
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BRAND NEW FANS
Quality, new fans for use in power amps, computers, hotspot cooling etc. Anywhere you need plenty of air
240V 4⅝ Cat T12461 $14.95
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115V 3½ Cat T12467 $14.95
10 + fans (mixed) only $10 each!
FAN GUARDS TO SUIT
4⅝ Cat T12471 $3.95
3½ Cat T12475 $3.95
MINIATURE HEATSINK!
A great little fellow if you are short of space. Great price too because we import direct so you save!
Dimensions 19(L) x 13(W) x 9(H)mm
Cat No 1-9 10+
H10606 $0.40 $0.35
HIGH EFFICIENCY RADIAL FIN HEATSINK
Black anodised with a thick base plate, this radial fin heatsink can dissipate large amounts of heat for maximum efficiency
Designed by Rod Irving
H10520 105 x 30mm $ 3.50
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H10549 105 x 300mm $12.95
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Leakproof and in 3 convenient sizes, these long service life batteries are ideal for burgular systems, emergency lighting or as a computer backup power supply. Ideal for many power needs
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REGULAR SOLDER SUCKER
• Light weight
• Sturdy construction
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• Excellent value for money!
Cat T11271 $11.95
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• Light weight
• Sturdy construction
• Easy to remove tip
• Excellent value for money!
Cat T11281 $13.95
"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! 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
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5¼" "NO BRAND" DISKS
DOUBLE SIDED DOUBLE DENSITY
10 + DISKS 100 + DISKS 1 000 + DISKS
$9.00** $8.50** $8.00**
(ALL PRICES PER 10 DISKS)
3½" "NO BRAND" DISKS
DOUBLE SIDED DOUBLE DENSITY
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(ALL PRICES PER 10 DISKS)
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WELLER WTCPN SOLDERING STATION
The WTCPN Features
• Power Unit 240 V AC
• Temperature controlled iron, 24 V AC
• Flexible silicon lead for ease of use
• Can be left on without fear of damaged tips!
The best is always worth having
Cat T12500 R.R.P. $149
SPECIAL, ONLY $129
ADCOLA SOLDERING IRONS
These are professional quality precision soldering tools, similar to those used by the Australian Military Services and industry for the manufacture, repair and rework of advanced electronic circuits and other scientific equipment
ADCOLA RS30 12 WATT
• 3mm tip
• 240V operation
• 3 months warranty
• Safety Standards Approved
Cat T12625 Normally $36.00
Special, only $32.00
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PC BOARD HOLDER
Better than an extra pair of hands!
A must for all PCB work
Cat T12444 $9.95
UV EPROM ERASER
Erase your EPROMs quickly and safely. This unit is the cost effective solution to your problems. It will erase up to 9 x 24 pin devices in complete safety, in about 40 minutes (less for less chips)
Features include
• Chip drawer has conductive foam pad
• Mains powered
• High UV intensity at chip surface ensures EPROMs are thoroughly erased
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• Dimensions 217 x 80 x 68mm
WITHOUT TIMER
Cat X14950 Normally $119
Special, $99
WITH BUILT-IN TIMER
Cat X14955 $139
Special, $119
ADCOLA E024 SOLDER SYSTEM
The E024 is a top quality Australian made soldering station suitable for use with either the Adcola CT-6, CT-7 irons or desoldering pencil. The E024 features a continuosly adjustable temperature range from 200°C to 400°C. The E024's electronic temperature control circuit monitors the temperature element in each of the irons allowing it to maintain a constant temperature to within an incredible ± 5°C of the temperature dial setting on the front panel
Power to the irons is via a "zero crossing" controller. The power to the irons is switched on/off at a point on the AC power supply where the voltage passes through zero. Hazardous spikes caused by commutated AC are avoided using this technique
Mains spikes are virtually eliminated by an electrostatic shield wound between the primary and secondry of the power transformer, an important safegaurd for easily damaged MOS devices. To further safegaurd sensitive components, an auxiliary ground lead earths the equipment to be soldered to the same level as the solder station, limiting the effective tip EMF to approximately 10mV. (Well below the damage level for MOS devices). If static control is important the E024 unit is an excellent choice
E024 Base Station with:
CT7 Iron.
Cat.T12570 .... $165
Base Station with:
CT7 Iron & Desoldering Tool
Cat.T12580 .... $220
FREE STANDING, FOLD UP MAGNIFIER
An economically priced "hands free" magnifier, lets you take care of all those tricky fine detailed jobs so often encountered in electronics, or any of many other practical uses such as home, work, hobbies etc
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SPECIAL, ONLY $12.95
KEY SWITCHES
Cat S12500 1-9 $4.95ea 10+ $4.25ea Normally $7.95 25+ $3.95ea
SURGE BUSTER!
6 PROTECTED POWER OUTLETS!
Protect your valuable electronic equipment from damaging power surges. Ideal for protecting personal computers, video equipment, colour TVs, amplifiers, tuners, graphic equalisers, CD players etc
SPECIFICATIONS:
Electrical rating 240V AC, 50Hz 10A
Complies with Australian Standards Approval number N10084
3 x Metal Oxide Varistors (MOV)
Surge/Spike Rating (each MOV) 4 500 amps (8x 20us)
Energy Absorbtion Factor each MOV 75 joules (10 x 1000us)
Maximum Clamping Voltage each MOV 710 volts at 50 amps
Response time Less than 25 Nanoseconds
X10086
Normally $69.95
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Alligator Analogue

Agreement has been reached by six organisations from five member countries of the OECD Nuclear Energy Agency (NEA) to start an international research project, called the International Alligator Rivers Analogue Project.

The research will involve studying the geochemical and hydrogeological processes acting upon the Koongarra uranium ore deposit in the Alligator Rivers region of the NT, which may resemble those processes acting upon a high-level radioactive waste disposal facility.

The project will be managed by the Australian Nuclear Science and Technology Organisation (ANSTO).

At present the participants are ANSTO, the Japan Atomic Energy Research Institute, the Swedish Nuclear Power Inspectorate, the Inspectorate of Pollution of the British Department of the Environment, the US Nuclear Regulatory Commission and, as an associate participant, the Power Reactor and Nuclear Fuel Development Corporation of Japan.

Pentagon Funds Superconductivity Research

The US defence department is giving a boost to the search for practical applications for superconductivity, and will fund 20 teams to participate in its high-temperature superdonductivity program.

The program, sponsored by the Defense Advanced Research Projects Agency and the Office of Naval Research, will concentrate on the processes to manufacture superconductor materials as much as the development of new superconducting devices.

Total funding for the first year is approximately (US)$15 million, with individual contracts for the year ranging from $100,000 to $2 million.

The three areas of emphasis will be:

- To develop the processes to fabricate superconductive materials in general shapes and sizes for engineering purposes.
- To devise controls for the manufacturing processes to permit high-quality mass production.
- To develop new superconducting devices.

Potential military applications for high temperature superconductive materials range from bearings and motors to gyrotrons and free-electron lasers. They may also be used for microwave/millimeterwave sensors, and to connect logic and memory chips in computers.

Radiant Shoes

The United States imports roughly (US)$3.5 billion more in leather goods each year than it exports. And while imbalances in semi-conductors and automobiles dominate trade talks and inspire legislation, the leather deficit concerns many.

One of those is Frank Scholnick, a research chemist at the US Department of Agriculture's Eastern Regional Research Center in Philadelphia. By irradiating hides with short ultraviolet bursts of radiation that improve finished leather, the USDA hopes to boost the quality of domestic leather products. While the process has not yet reached the commercial production stage, several companies are interested, Scholnick said.

One motivation for Scholnick's team to modernize leather tanning and curing techniques stems from federal restrictions on pollution. Strict regulations contribute additional cost to the production of domestic leathers , while controls in some other countries are far less stringent, and therefore less costly.

The leather-finishing process Scholnick is studying at the Agriculture Department's Eastern Regional Research Center, he says, does the job more quickly and cleanly than conventional methods. A piece of leather rides a 10-foot long conveyor belt moving at 22 to 30 feet (7 to 9 meters) per minute. An acrylic film is sprayed onto the leather, which is immediately exposed to a few seconds of 210- to 400-nanometer ultraviolet rays or 160- to 200-kilovolt electron-beams. The radiation seals and strengthens the film by inducting the acrylic molecules to form heavier, stronger polymer chains.

Because the process takes only a few minutes, against the several hours needed for conventional hot-air drying ovens, it cuts down energy consumption substantially — by 60 per cent for ultraviolet treaments and 84 per cent for electron-beam techniques.

Furthermore, because no solvents are required, such radiation curing and tanning is also cleaner than conventional methods. Chemical solvents, when heated, evaporate and cause pollution; radiation finishing releases no solvent vapors.

Even better, Agriculture Department scientists say, radiation-cured leather has its own esthetic qualities.

The Hot Seat

In these days of high crime rates, few are more vulnerable to criminals than cabbies. Strapped in their cars, sometimes with windows closed, they are vitually shut off from help should they be threatened by a robbery.

Yair Tanami, an Israeli, recently applied to patent a protection system for cab drivers. It delivers an immobilizing 60,000-volt shock to the threatening passenger's rear end that will hopefully cause him to drop his weapon. Tanami says the dose is enough to disable temporarily, but not to cause serious injury.

To prevent unintentional zappings, the system operates in two steps: when a suspicious looking person enters the taxi, the driver can step on a foot switch to ready the discharge electrodes worked into the passenger-seat upholstery and connected to the car's battery and a high-voltage generator. If the suspicions are confirmed, the cabbie presses a second foot switch that sends the pulsed current to the electrodes and momentarily paralyzes the troublemaker.

In New York City, the police department recently instituted random checks of cabs at night in an attempt to curb rising cab crime. The city's Taxi and Limousine Commission, however, looked at the device and decided it would be unlawful. Indeed, one cab driver voiced concern that the shock might kill someone with a heart condition. Then, he said, the cab driver would become the threat instead of the victim.

Swedish ID card

Swedish security

Besam of Sweden recently demonstrated its new four-wing, one or two-way, revolving security entrance door. The door system is said to feature microprocessor-based electronic circuitry to enable various security functions to be performed simultaneously. A security entrance system with a ceiling detector which senses the presence of pedestrian traffic, or floor mats, limit passage to individuals with proper clearance.

In operation the pedestrian approaches the revolving entrance. Rotation begins by card reader or push button activation and authorised traffic passes through the entrance. If an unauthorised person attempts to go through the door then the system detects their presence and stops the door rotation.

Bad Art Contest

An American graphics design company is sponsoring a "Bad Art" contest to call attention to what the firm perceives as a lack of design standards in the electronic publishing industry. The "winning" entries will be hung in the firm's Hall of Shame.

Bruce Ryon, president of Design Access, said the contest was inspired by a recent flood of "graphically atrocious" ads created with EP systems.

"The more hapless efforts . . . of aesthetically impaired desktop publishing . . . should be preserved for posterity, like TV bloopers, man-bites-dog headlines, or those early films of airplanes that never got off the ground," Ryon said.

The contest is open to anyone, but all entries must have been fully or partially produced using computer-based graphics design and EP systems, including electronic typesetting equipment, he said.

Prizes will be "awarded" for the most confusing document, the highest number of graphics elements in a single design, the worst layout, and the worst use of colour, fonts, and clip art. At the whim of the judges, ad-hoc prizes may also be awarded.

"We want to encourage people to send in anything they think is truly awful," Ryon said.

Generally, the prizes will go to those who submit the winning entries, unless the originators are judged to be more deserving.

The grand prize will be a copy of a graphic design program and a complimentary "makeover". Books on graphic design, magazine subscriptions, and other prizes will also be presented.

Appropriately enough the contest opens on April 1.

CAD/CAM to AMTE

The Victorian CAD/CAM Centre has changed its name to the Advanced Manufacturing Technology Centre Ltd (AMTEC), reflecting the planned expansion of the centre's extensive CAD/CAM facilities into a full-scale, flexible manufacturing demonstration facility.

AMTEC — a non-profit company funded by the Victorian Government and run by a board with representatives from employers, unions and the government — offers independent consulting services to Victorian manufacturers on the application of advanced technology to the manufacturing process.

The first stage of AMTEC's flexible manufacturing demonstration cell will comprise a four-axis Farley profiling centre, both served by a Machine Dynamics gantry robot. The cell will be controlled by microcomputer, and AMTEC aims to use Manufacturing Automation Protocol (MAP) as the communication language.

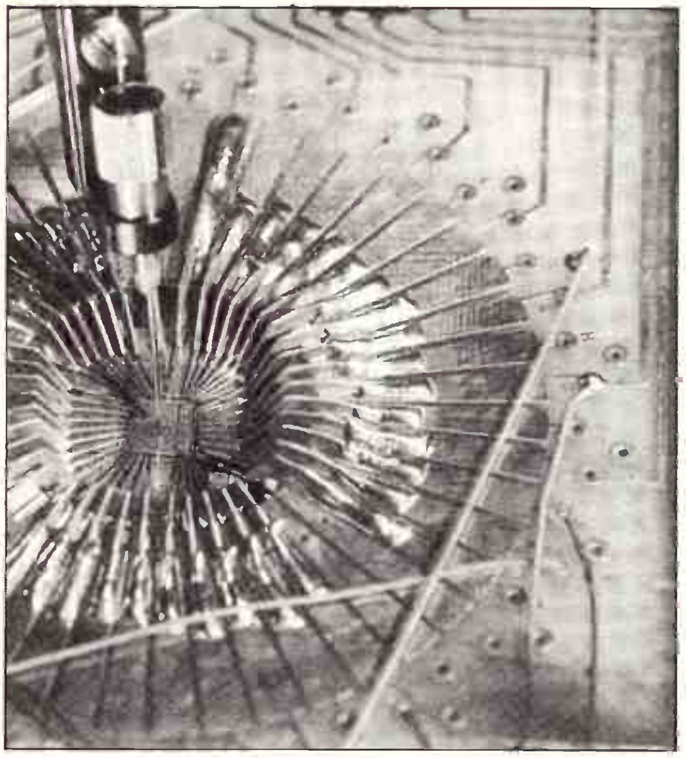
Stages two and three involve a die-casting facility and extension of its automated assembley capabilities, including robot welding.

AMTEC's general manager, Mr John Cummings,said the centre welcomed approaches from manufacturers which wanted to use the cell facilities for product and production development.

The centre would work with companies on all aspects of a project, from design through to small batch production, he said.

Errata

A mistake has been made in the circuit for the ten pin bowling game (feed forward ETI Nov. 87). The output from the monostable IC1b must be capacitively coupled to all the reset lines.



Self Testing Chips

The British electronics company Plessey has developed a method of checking whether an integrated circuit is working correctly. The software package is called SHADE. SHADE can calculate all the ways in which the circuit could fail, and store the information until required.

The ICs self test capability is activated by asserting a single pin input. A test signal comes back and is compared with a SHADE generated test vector. In the event of a failure, SHADE can pinpoint the position of the failure.

William Gosling, the technical director of Plessey, says that the self-test chips are 5 per cent slower and 20 per cent bigger than their conventional counterparts. Bigger chips need more silicon and so cost more.

But because the chips test themselves, there is no need for conventional testing equipment (costing $20 million to $30 million) at the end of every production line. The advantage and disadvantages balance out.

Plessey began developing the SHADE package four years ago to try to speed up the design of custom chips or ASICs, and to make them cheaper. At the same time, Gosling claims, the company carried out a study that showed that testing chips by conventional techniques would be so difficult with the very complex chips of the future that it would take the useful lifetime of the chip to do it.

Plessey claims the chips can test themselves for faults in 0.6 seconds. These tests, according to Plessey, are far more exhaustive than checks currently carried out at the end of chip production lines. They also mean that the chip can be tested as frequently as needed, and is out of use only very briefly.

Plessey and the British Ministry of Defence are carrying out final tests of self-testing chips. Next, Plessey will look for a partner to provide a backup source of the technology for its customers, by licensing a chip manufacturer, or a software company.

Bottom Buoyant

There is growing evidence that Australian industry is becoming more internationally competitive and export orientated, says Industry, Technology and Commerce minister John Button.

Releasing a report called Australian Industry — new directions he said, "The report is designed to provide a wide audience at home and abroad with a better understanding of how Australia's industrial capability is progressing," Senator Button said.

The report claims to be a review of how the environment has changed to make Australian industry more competitive and how Australian industry is responding to this new competitiveness, rather than a White Paper on the Government's objectives and policies.

According to the report, key features of the improved competitive situation are:

- the depreciation of the Australian dollar by one-third against the trade weighted index;
- the decline in real unit labour costs;
- the marked reduction in industrial disputes (although the report notes the need for greater co-operation and improved performance in this area);
- the major reductions in tariff protection and exposure of Australian industry to world trade; and
- the better targeting and utilisation of Australia's well developed research capacity to the needs of industry.

The report examines the response of Australian industry to the improved environment of the national level and at the firm level.

Reference is made in the report to nearly 300 companies and the contribution they have made to the 'new directions' being achieved by Australian industry. These companies are spread over a wide range of industries. They have achieved real progress with respect to technology and product development, exporting, cost reduction, management or some other aspect of improved performance.

A copy is available from DITAC in Canberra.

Tax Guide

The Industry Research and Development Board has released the first in a series of "R&D Tax Concession Guidelines" to promote better understanding of the concession and to increase Australian business investment in R&D.

The guidelines are written in easy-to-understand language and, in most cases, are one-page fact sheets. The initial set of five guidelines addresses the issues of eligibility, registration and the project basis on which claims should be sustantiated.

The Board's Chairman, Mr Bill Kricker, said the guidelines were essential reading for companies which were undertaking R&D activities and which should be considering using the concession.

"The publication of the guidelines is a further step in the Government's moves to promote understanding of the concession and to increase, to a level at least equivalent to other developed countries, Australian business investment in R&D," Mr Kricker said.

The guidelines are being circulated to companies which have registered for the concession, tax advisors, relevant professional associations, and various other service agencies.

The guidelines are available from offices of the Department of Industry, Technology and Commerce in Canberra on 008-026121, or from its offices in each State.

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INDIVIDUAL COMPONENTS TO MAKE UP A SUPERB HIFI SYSTEM!

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POWER AMPLIFIER

WHY YOU SHOULD BUY A "ROD IRVING ELECTRONICS" SERIES 5000 POWER AMPLIFIER

- 1% Metal Film resistors

SPECIAL, ONLY $399
SAVE $50

... developed by ... ELECTRONICS and is being supplied to other kit suppliers.

SPECIFICATIONS: 150 W RMS into 4 ohms (per channel)
POWER AMPLIFIER: 100W RMS into 8 ohms (+ - 55V Supply)
FREQUENCY RESPONSE: 8Hz to 20Hz +0 - 0.4 dB 2 8Hz to 65KHz +0 - 3 dB NOTE These figures are determined solely by passive filters
INPUT SENSITIVITY: 1 V RMS for 100W ouput
HUM: 100 dB below full output (flat)
NOISE: 116 dB below full output (flat, 20KHz bandwidth)
2nd HARMONIC DISTORTION: -0.001% at 1 KHz (0.0007% on Prototypes) at 100W ouput using a + - 56V SUPPLY rated at 4A continuous -0.0003% for all frequencies less than 10KHz and all powers below clipping
TOTAL HARMONIC DISTORTION: Determined by 2nd Harmonic Distortion (see above)
INTERMODULATION DISTORTION: 0.003% at 100W (50Hz and 7KHz mixed 4 1)
STABILITY: Unconditional

Cat. K44771 .... $449
Assembled and tested $599
packing and post $10

PREAMPLIFIER

THE ADVANTAGES OF BUYING A "ROD IRVING ELECTRONICS" SERIES 5000 PREAMPLIFIER

- 1% Metal F...

SPECIAL, ONLY $359
SAVE $40

... believe that dollar for ... commercial unit available that sounds as ...

SPECIFICATIONS:
FREQUENCY RESPONSE: High-level input 15Hz - 130KHz + 0 - 1dB Low-Level input-conforms to RIAA equalisation + - 0.2dB
DISTORTION: 1KHz -0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation)
S/N NOISE: High-Level input master full with respect to 300mV input signal at full output (1.2V)-92dB flat -100dB A-weighted MM input master full, with respect to full output (1.2V) at 5 mV input 50ohms source resistance connected -86dB flat/92dB A-weighted MC input, master full, with respect to full output (1.2V) and 200uV input signal -71dB flat -75dB A-weighted

Cat. K44791 .... $399
Assembled and tested $699
packing and postage $10

THIRD OCTAVE GRAPHIC EQUALIZER

SPECIFICATIONS:
BANDS: 28 Bands/...

SPECIAL, ONLY $209
SAVE $30

Cat. K44590 .... 1 unit: $239
.... 2 units: $429
packing and postage $10

SERIES 4000 SPEAKERS

8 Speakers .... only $549
8 Speakers with Crossovers ... $795
Speaker Cabinet Kit (complete) $395
(Please specify cabinet to suit 7" or 8" mid range woofer)
Crossover Kits $295
Complete kit of parts (speakers, crossovers, screws, innerband boxes.) $1,095
Assembled, tested and ready to hook up to your system ... $1,295
(Approximately 4 weeks delivery)

Errors and Ommissions Excepted

SAVE $10

30 V/1 A FULLY PROTECTED POWER SUPPLY

The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limit. Both volatage and current metering is provided (ETI Dec 83) ETI 162

Cat K41620 Normally $73.50
SPECIAL, $63.50

KITS

ZENER TESTER

A simple low cost add-on for your multimeter. This checks zeners and reads out the zener voltage directly on your multimeter. It can also check LEDs and ordinary diodes (ETI May 83) ETI 164

Cat K41640 $11.95

BIPOLAR PROM PROGRAMMER KIT

Every digital workshop should have one! Can be used to program the popular fusible-link PROMS like the 74S188 288 82S23 & 82S123 etc (ETI June 83) ETI 688

Cat K46880 $69.95

SERIES 4000 STEREO PREAMP

This high performance project is designed to complement ETI's 60 watt low distortion amplifier module and forms part of a complete stereo system, the "Series 4000" project (ETI 471) (Top Projects Vol 6)

Cat K44710 $59.95

GENERAL PURPOSE PREAMPLIFIER

A general purpose stereo preamplifier using a single LM382 IC which can be tailored for use with magnetic pickups, tape recorders or microphones by changing a few components (ETI445) (ETI July 76)

Cat K44490 $9.95

OP AMP TESTER

The Op Amp Tester which could save you hours in agonising whether that old op amp thats been sitting in the draw for the last year (ETI April 85, ETI 183)

Cat K41830 Normally $26.50
SPECIAL, $21.50

150W MOSFET POWER AMPLIFIER

Here's a high power, general purpose 150W Mosfet Power Amp Module! Suitable for guitar and P.A. applications and employing rugged reliable Mosfets in the output stage (ETI 499) (ETI March 82)

Cat K44990 $97.50
(Heatsink not included)
plus transformer $49.50

1W AUDIO AMPLIFIER

A low-cost general-purpose 1 watt audio amplifier, suitable for increasing your computers audio level etc (EA Nov 84)

Cat $9.95

EA AM STEREO DECODER

AM stereo is now broadcast in Australia on an experimental basis. This add-on decoder works with the Motorola C-QUAM system (EA Oct 84) 84MS10

Cat K84100 Normally $26.95
SPECIAL, $16.95

SAVE $10

PLAYMASTER 300 WATT AMPLIFIER

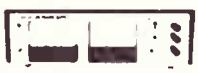
This module will deliver up to 200 watts into an 8 ohm load and up to 300 watts into a 4 ohm load. Comprehensive protection is included and a printer circuit board brings it all together in a rugged easy-to-build module. It can be built in either fully-complementary or quasi-complementary versions so output transistor shortages should be no problem at all (80PA6) (EA July 80)

Cat K80060 Normally $109
SPECIAL, ONLY $99
(Heatsink not included)

ELECTRIC FENCE CONTROLLER

Restore discipline to the farm or allotment with this new electric fence controller. It features higher output power and lower current drain than the previous design for use in rural areas (EA Dec 85 85ef11)

Cat K85110 Normally $49.95
SPECIAL, $45.95



50V 5A LABORATORY POWER SUPPLY

New switchmode supply can deliver anywhere from three to 50V DC and currents of 5A at 35V or lower. Highly efficient design (Ea May June 83) 83PS5

Cat K83050 $199

50 W AMPLIFIER MODULE (ETI 480)

Cat K44880 Normally $31.80
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(Heatsink optional extra)

100 W AMPLIFIER MODULE (ETI 480)

Cat K44801 Normally $34.80
SPECIAL, $26.95
(Heatsink optional extra)

LOW BATTERY VOLTAGE INDICATOR

Knowing your batteries are about to give up on you could save many an embarrassing situation. This simple low cost project will give your early warning of power failure and makes a handy beginner's project (ETI 280, March 85)

Cat K42800 $9.95

MICROBEE SERIAL-TO-PARALLEL INTERFACE

Most microcomputers worth owning have an RS232 connector or port through which serial communications (input/output) is conducted. It is a convention that for listing on a printer the BASIC LLIST or LPRINT command assumes a printer is connected to the RS232 port. Problem is serial interface printers are more expensive than parallel Centronics interface printers. Save money by building this interface (ETI Jan 84) ETI 675

Cat K46750 Normally $49.50
SPECIAL, $29.50

CRYSTAL CONTROLLED TV PATTERN GENERATOR

Anyone wishing to obtain the maximum performance from a colour TV reciever needs a pattern generator. Why not build this superb unit which provides five separate patterns, dot, crosshatch, checker board, grey scale and white raster? Note: The RIE kit includes a large ABS type case! (80pg6 EA June 80)

Cat K80033 $99.95

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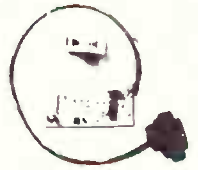

RADIOTELETYPE CONVERTER FOR THE MICROBEE

Have your computer print the latest news from the international shortwave news service. Just hook up this project between your short wave receivers audio output and the MicroBee parallel port. A simple bit of software does the decoding. Can be hooked up to other computers too (ETI Apr 83)

Cat K47330 $19.95

MUSICOLOR IV

Add excitement to parties, card nights and discos with EA's Musicolor IV light show. This is the latest in the famous line of musicolors and it offers features such as four channel "color organ" plus four channel light chaser, front panel LED display, internal microphone, single sensitivity control plus opto-coupled switching for increased safety (EA Aug '81) 81MC8

Cat K81080 $114.95

MULTI SECTOR ALARM STATION

Protect your home and possessions from burglars with this up to the minute burglar alarm system. It's easy to build, costs less than equivalent commercial units and features eight seperate inputs, individual sector control, battery back up and self-test facility.

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- Resistive loop sensing suits both normally open and normally closed alarm sensors
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- Built-in siren driver

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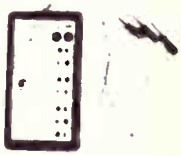
K85901 without battery backup ~~$134~~
SPECIAL, $115
K85900 complete kit ~~$159~~
SPECIAL, $129



TRANSISTOR TESTER

Have you ever desoldered a suspect transistor only to find that it checks OK? Trouble-shooting exercises are often hindered by this type of false alarm, but many of them could be avoided with an "in-circuit" component tester such as the EA Handy Tester (EA Sept 83) 83TT8

Cat K83080 Normally $18.95
SPECIAL, $15.95

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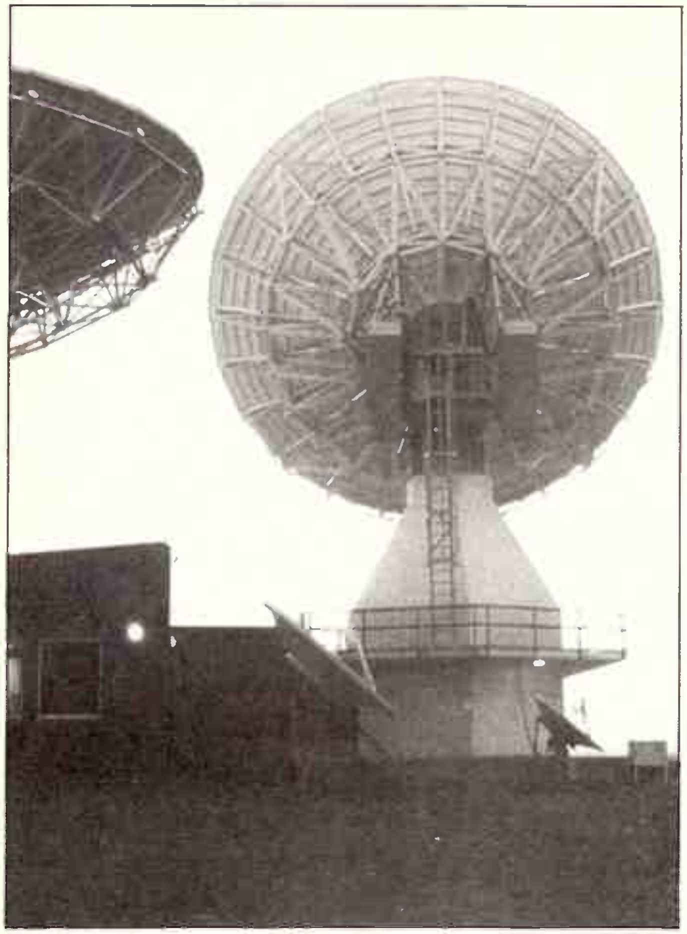

Small Computer Moves

Vandata is a new business that opened in the Midway Arcade, Ringwood, Vic in July 1987, to design and manufacture software and hardware for very small computers (often called controllers). The engineering proprietor, Eddie Vanda, who previously operated out of his home, has made the move because of increasing business.

Vandata has already completed a number of projects since last July. Among these was the provision of the software to run each of the 26 Advise traffic controllers recently installed along Canterbury Road, Sydney. (These signs were made by Mach Systems for the RTA and CSIRO). Vandata was also subcontracted to design the hardware and software for the digital control of a Fail Proof anti theft car system. A current project involves the provision of software for a chemical dosing system for a major chemical company.

Eddie Vanda was a radio engineer with the Royal Australian Air Force for twenty years until January, 1987. He then became R & D manager for Mach System until he started his own business.

Probe Measures Fastest Pulses

Circuit designers aiming to optimize circuit speeds are taking their first direct look inside microelectronic devices at electrical pulses that last less than a picosecond.

This is made possible by an electro-optic technique invented and recently perfected by AT&T Bell Laboratories researcher Janis Valdmanis, who has just received the 1988 Adolph Lomb Medal from the Optical Society of America for this work.

The new system permits designers to measure signals with a resolution of less than 0.3 picoseconds — two orders of magnitude faster than conventional electronic measurement systems. Measurements can be taken on any kind of circuit material — silicon, gallium arsenide, ceramic or hybrids — without requiring a specialised circuit design to accommodate testing.

The system can measure electrical signals 100 times faster than those in the 10-gigahertz range seen by sampling oscilloscopes, the most common technique for measuring fast electrical pulses today.

The key element in the instrument is a tiny electro-optic crystal made of lithium tantalate that has been honed at the tip to a point just 40 microns across. Using a high resolution microscope, the crystal can be brought down near any point on an integrated circuit to sense local electric fields around the conductors and on-chip connections. These fields, which correspond to voltage variations on the conducting lines of the circuit, change the optical properties of the crystal. This change, in turn, is measured by shining subpicosecond laser pulses through the crystal and measuring their change in intensity.

A scientist looking through the microscope can train the electro-optic tip and the micro-sized spot of laser light onto virtually any point of the circuit desired, gaining an electrical "window" into a world of features just microns wide.

Already, developers of integrated circuits and microwave structures at AT&T are making use of this new technique.

Top 100

The Top 100 electronics companies in Australia generated electronics revenues of $3092 million during 1986/87, with the top 10 accounting for 70% of these sales.

A report just released by Electronics Market Research Group, a division of Thomson publishers, lists the Top 100 electronics companies, from AWA in Number 1 spot with electronics sales of $387.9 million, to a group of small companies that share final spot with sales of $3 million each.

The Top 100 Electronics Companies report covers communications, components, instrumentation and systems suppliers, but excludes computer companies that generate the majority of their revenue from office automation/data processing markets, (eg: IBM, Wang, Apple).

The report identifies the overseas owned communications manufacturers as the dominant force in the Australian electronics industry. Companies like STC, NEC, Ericsson, Siemens and GEC posted electronics sales that were 10 to 20 times bigger than the average turnover of most so-called large Australian owned electronics manufacturers and distributors.

Companies that are wholly Australian owned make up about 63% of the Top 100, but it is the overseas owned businesses that dominate in terms of dollars. In the Top 10, only two companies are locally owned, AWA, and the Number 10 company, IGL Electronics with sales of $79 million (IGL is a new company, spawned by Anitech).

BOOKS BOO[KS]

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C.A. Miller BP120
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HOW TO DESIGN ELECTRONIC PROJECTS
R. A. Penfold BPO127
The aim of this book is to help the reader to put together projects from standard circuit books with a minimum of trial and error, but without resorting to any advanced mathematics. Hints on designing circuit blocks to meet your special requirements where no "stock" design is available are also provided. *128 pages* $9.00

COIL DESIGN AND CONSTRUCTION MANUAL
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Chart

IC 555 PROJECTS
E. A. Parr BP0044
Every so often a device appears that is so useful that one wonders how life went on before without it. The 555 timer is such a device. Included in this book are basic and general circuits, motorcar and model railway circuits, alarms and noice-makers as well as a section on 566, 568 and 569 timers. *176 pages* $9.50

RADIO AND ELECTRONIC COLOUR CODES AND DATA CHART
B. B. Babani BP0007
Covers many colour codes in use throughout the world, for most radio and electronic, components. Includes resistors, capacitors, transformers, field costs, fuses, battery leads, speakers, etc. *Chart* $4.00

HOW TO GET YOUR ELECTRONIC PROJECTS WORKING
R. A. Penfold BP0110
The aim of this book is to help the reader overcome problems by indicating how and when to start looking for many of the common faults that can occur when building up projects. Chapter 1 deals with mechanical faults such as tracing dry joints, short-circuits, broken P.C.B. tracks, etc. The construction and use of a tristate continuity tester, to help in the above, is also covered. Chapter 2 deals with linear analogue circuits and also covers the use and construction of a signal injector/tracer which can be used to locate and isolate the faulty areas in a project. Chapter 3 considers ways of testing the more common components such as resistors, capacitors, op amps, diodes, transistors, SCRs, uni junctions, etc, with the aid of only a limited amount of test equipment. Chapter 4 deals with both TTL and CMOS and logic circuits and includes the use and construction of a pulse generator to help fault-finding. *96 pages* $8.50

ELECTRONIC SECURITY DEVICES
R. A. Penfold BP0056
Many people associate the term "security device" with only burglar alarms of various types, but in fact, any piece of equipment which helps to protect people and property against any form of danger could be termed a "security device". Therefore this book, besides including both simple and more sophisticated burglar alarm circuits using light, infra-red and ultrasonics, also includes many other types of as well, such as gas and smoke detectors, flood alarms, doorphone and baby alarms, etc. *112 pages* $9.50

ELECTRONIC HOBBYISTS HANDBOOK
R. A. Penfold BP233
A handy data reference book, written especially for the newcomer to electronics. Provides data on component colour codes, IC families, basic power supply circuits, circuit symbols, op-amp connections, testing transistors and SCRs, basic computer interfaces, morse code and lots more. $16.00

ELECTRONIC TEST EQUIPMENT CONSTRUCTION
F. G. Rayer BP0075
This book covers in detail, the construction of a wide range of test equipment for both the electronics hobbyist and radio amateur. Included are projects ranging from a FET amplified voltmeter and resistance bridge to a field-strength indicator and heterodyne frequency meter. Not only can the home constructor enjoy building the equipment but the finished product can also be usefully utilised in the furtherance of his hobby. *96 pages* $8.00

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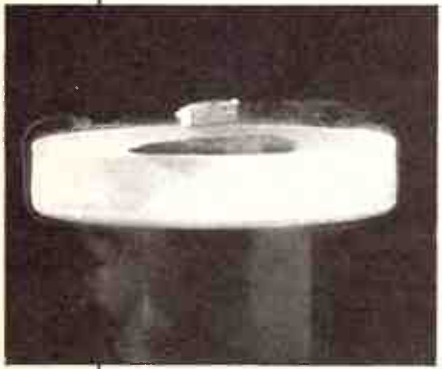

Meissner Motor

Researchers at the Argonne National Laboratory in the US have built the first electric motor based on high-temperature superconductors.

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.

The motor was built to show that simple, operating motors can be made with super-conducting ceramics.

It is too small for practical use 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.

Meanwhile, in the UK, the Department of Trade and Industry has announced that it is to spend £8 million on collaborative research into high-temperature super-conductivity. It expects industry to match the awards, bringing funds for the programme to £16 million over three years.

The scheme follows the decision by the Science and Engineering Research Council (SERC) in December to spend £5.3 million on a university research centre for high-temperature superconductivity, based at Cambridge. The research council will also fund separate projects to the tune of around £2 million a year. The DTI intends its scheme to complement this work.

BAe Contract

The big UK aerospace concern, British Aerospace, has been awarded contracts valued at more than $350,000 to undertake studies leading to the design and manufacture of the second generation of European Meteosat weather satellites.

The contracts, awarded to BAe's Space and Communications Division by the European Space Agency, are for a spacecraft systems study and a study for a microwave sounder — one of three principal instruments planned for the new generation of Meteosat satellites, expected to commence service in geostationary orbit, by the mid 1990s.

Meteosat satellites, operated by the European weather satellite organisation, Eumetsat, provide meteorologists with valuable data including the pictures which have become a regular feature of television weather forecasts. In addition to producing raw images and relaying processed data, Meteosat also relays data collected by remote Earth stations, weather balloons, and buoys at sea.

There are two Meteosat satellites in service. Meteosat 1 was launched in 1977, followed by Meteosat 2 in 1981. These satellites form the basis of the Meteosat pre-operational Programme, which will be followed by the Meteosat Operational Programme (MOP). MOP 1, 2 and 3 are scheduled for launch by Ariane rocket in September 1988, December 1989 and January 1991 respectively. To date, all Meteosat satellites have been 'spin stabilised' in design.

Meteost satellites have a global disc coverage which includes Europe, the Atlantic, the Middle-East and Africa.

The planned second generation Meteosat payload will include a Microwave Sounder, and Imaging Radiometer, an Infra-red Sounder and other scientific instruments.

The new system will help to improve the accuracy of weather forecasts by providing better pictures and more data, including temperature and humidity profiles of the atmosphere. Capable of gathering data during the eclipse phase, it will provide important information about night time weather patterns.

Work on the study contracts, to which other European aerospace companies will contribute, has been undertaken by BAe's Space and Communications Division Bristol site and will be completed by April 1988.

Meanwhile ESA is also working on plans for maritime and aeronautical satellite communication in the mid-1990s.

One project, known as Aramis, is a payload to be carried by the next generation but one of maritime communication satellites (Inmarsat 3). The technology of Aramis allows 1000 channels of communication, compared with the 125 on Inmarsat 2. The first Inmarsat 2 satellite will be launched in 1989.

Instead of transmitting power indiscriminately over, say, the whole of the Atlantic, (including areas where there may be no ships or aircraft to communicate with), Aramis concentrates power in spot beams to the areas where it is needed. As a result it makes more efficient use of the power on board than current maritime stellites.

Current communication satellites like Aussat have spot beams, but these are fixed. The Aramis beam is produced by an array of elements, each capable of generating signals at the transmission frequency. By controlling the amplitude and phase of the signals produced by each element, Aramis will direct signals to different parts of the area.

Solitons

Scientists working for IBM have published a paper in the Physical Review of letters (V60 p29) in which they claim to have produced a negative soliton, or dark pulse.

Solitons were first discovered more than a century ago by John Scott Russell, a Scottish scientist. Russell observed a water wave travelling along a canal for many miles. He named this wave a "solitary wave". American researchers contracted this to "soliton" when they produced such waves with light in the 1930s.

Since then, theoretical physicists have wondered whether the same effect could be produced in "dark pulses". By a dark pulse, they mean a short interruption in a steady beam of light.

The work is, potentially, of great interest to communications companies.

Normally, a pulse of light spreads out as it travels along an optical fibre. This happens because parts of the light pulse travel at different speeds in the fibre. As the intensity of the pulse increases another effect comes into play, which squeezes the pulse. If the intensity of the pulse is increase to a certain level the effects balance each other out.

When this happens the pulse becomes a soliton. It stretches and compresses as it travels down the optical fibre but it maintains its overall shape.

Currently, pulse dispersion is the thing that limits bandwidth and distance in a fibre. If the IBMers can actually produce solitons at will, the way is open for a dramatic expansion of bandwidth in fibres, as well as increases in the distance light can be piped before requiring amplification.

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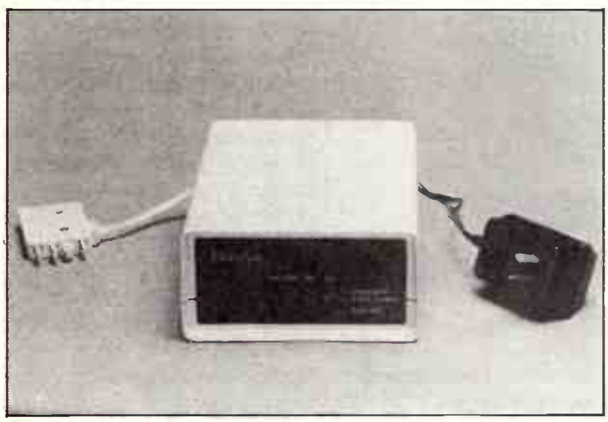

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Parallel Graphics

Digital Signal Processors (DSPs) are a new breed of the ICs that can do high speed sampling in real time. Up until now, they have been used experimentally in many audio and communications type applications (see News Digest, November 1987 p7). However, now engineers at AT&T have devised a way of building a powerful graphics system from combinations of many DSPs.

The system, called the Pixel Machine, relies on two different sorts of parallel processing. One is pipelined parallelism, where each chip in a chain or pipe works on a different part of the same problem. The other form involves an array of processors, each doing the same job but working on different elements of a picture. This method can be used to calaculate the shading and lighting effects on each element of a rotating image.

Designing three-dimensional models and calculating, shading and lighting effects as they rotate requires a lot of computer power, and systems that can do this usually contain special graphics chips added to standard microprocessors. But these have a limited number of functions. They can also take several hours to work out successive frames depicting rotating images.

The pipeline of DSP chips has the advantage that users can change software instructions according to the task in hand, making it more flexible than machines based on chips dedicated to specific types of design. Using each chip in a pipe to carry out different parts of the same job is a good method for rotating the image, or for changing the textures on the surface of an image, claims AT&T.

The pipeline first processes information on each frame of a moving image and then passes the resulting data on to the array which can calculate shading effects for each version of the image.

AT&T says that designing new frames of an image of recursive spheres (spheres which are surrounded by smaller spheres which, in turn, are surrounded by smaller spheres) takes less than 30 seconds.

Bank Installs Fibre Optics

The National Australia Bank has installed an optical fibre network at one of its major administrative centres in Melbourne, with results described by the Bank as "extremely satisfying".

The project involved internal reticulation of fibre optic cable for building backbone cabling associted with an advanced building cabling system. Olex Cables, supplies the fibre optic components and ancillary rack equipment.

The purpose-built fibre optic network and the high technology building cabling system are used for interconnecting IBM terminals and departmental systems with an IBM mainframe, connecting remote Line Interface Modules of an L M Ericsson MD110 PABX, and supporting the building control system.

"It is estimated that the total backbone fibre bandwidth of the new network is 3.2 GHz in either direction using a single wavelength.

CFCs

Space and air borne instruments have now confirmed the existence of a hole in the antarctic ozone layer, and there is widespread agreement that it will reduce the ozone layer over Australia significantly within the next few years.

However, the exact physics of the ozone depletion are not understood. For instance, why is the antarctic singled out for special attention? Now a team of scientists has completed a months survey at the European Space Agencies tracking station at Kiruna in Sweden.

The hope to determine whether there is a "hole" in the ozone layer above the Arctic, like the one that has appeared in the Antarctic.

French and West German laboratories are supplying five balloons which will carry 35,000 to 100,000 cubic metres of equipment up to altitudes of 28 kilometres, collecting air samples to be dropped by parachute for later analysis.

The team plans to measure directly the levels of trace gases in the stratosphere, as an American team did in the Antarctic in September. Patrick Aimedian, a French member of the project, says that a high-speed, high-altitude airoplane from NASA will make six flights through the Arctic stratosphere. It will be equipped with a lidar, which uses the scattering of laser bursts to detect particles, and a mass spectrometer to measure ozone, and several other chemicals, including halogens and chlorofluorocarbons (CFCs), the industrial chemicals thought to destroy stratospheric ozone.

Meanwhile pressure for massive cuts in the production of chlorofluorocarbons (CFCs) is having its effect on the big chemical manufacturing companies. In the wake of the Montreal agreement, signed in September 1987, to halve the consumption of halogenated chlorofluorcarbons, thirteen competing companies from seven nations are joining together to speed the testing of alternative, less-damaging compounds.

Cushen's Radio Guide

Arthur Cushen, the well known radio identity and ETI columnist, has released a new book, the Radio Listeners Guide. It opens up a whole new world of radio listening and is designed for the new radio listener.

Cushen's cover many topics including: "Getting started on the higher bands," looking for clearer frequencies, and writing a reception report. He looks extensively at the world on mediumwave and includes a special list of news broadcasts in English from around the world.

There is also an extensive technical information section. He discusses ionospheric propogation, receivers and aerials. Another chapter covers time conversion, and looks at methods of calculating it.

Winner

The winner of the Achilles Fun Boat subscription and accessories offer which was drawn on 21/12/87 was B. D. Maclean, Sylvania Waters, NSW.

MIC Capital

The MIC Licensing Board has announced the following increases in approved capital for MICs:

	$ million
Austech Ventures Limited	4.5
Australian Pacific Technology Limited	3.
BT Innovation Limited	3.
Continental Venture Capital Limited	5.
CP Ventures Limited	3.
First MIC Limited	3.
SAMIC Limited	2.
Stinoc Limited	6.
Techniche Limited	6.5
Western Pacific Investment Company Limited	3.
Westintech Innovation Corporation Limited	2.
	41.

The Board's Chairman, Mr Ralph Ward-Ambler, said the decisions had been made against a background of the massive decline in Australian stock market values and the MICs' requests for increases in tax-concessional capital totalling $114.5 million.

The failure of CAPTAIN, the rise of videotel and the establishment of a private videotex system are some of the areas covered in this month's Videotex News

Videotex News

PC-Videotex Network in Japan

CAPTAIN, Japan's national videotex service, did not really get off the ground. After five years of trials, the service was launched in 1984. Four years later it still has less than 15,000 terminals connected to the service. The reason is mainly the expensive terminal price, $800, excluding a 4800 baud modem that will cost at least another $1000.

PC manufacturer Nintendo is now in the process of using CAPTAIN for a home service to connect all its PC's in the Japanese market to one network and offer a range of high quality services on the database. At the same time they intend to market their own videotex adaptor with disk drive for around $500. At present, the production plan for this equipment is 40,000 per month.

Germans Lease Terminals

The Bundespost has bought 50,000 Multitel terminals, the generic name for the Bildschirmtext (Btx) terminals with a built-in telephone — total value DM80 million. The terminals will be leased by the German PTT for DM48 per month for a b/w unit and DM78 for a colour unit.

Btx is to become profitable within five years, "for sure", and possibly within two years.

Referring to multi-standard networks, particularly networks that are ASCII compatible, a spokesman for Btx said that its network will be restricted to Bix standard display, mainly in order to avoid information loss problems. Several ASCII databases have put up Btx versions of their services.

One major future development is the ISDN (Integrated Systems Data Network) system that is to be coupled with the Btx network. "This will reduce the time needed to display a Btx page to 0.3 seconds per page. Btx-ISDN terminals will be, of course, more expensive but some applications more than justify the price," the spokesman said.

Videotel Moving Slowly

Videotel, the Italian videotex network run by SIP, the national telecom authority, has recently ended its test phase. It is currently using the Prestel standard and moving gradually to CEPT C1 (Btx = Bildschirmtext, the German Standard), so that Videotel will be running on a dual standard basis, Prestel—Btx. GEC in the UK installed the text system (Prestel) and has also implemented the new Btx system.

According to SIP, there are 219 information providers, and 2500 users of which 100 are home users. There are 14 gateways providing 129,000 pages. The annual number of calls is 250,000. Local call access is provided in 14 towns and should be extended to a total of 20 towns by the end of this year.

Dutch—German Vtx Interworking

The German Btx and the Dutch Viditel are implementing the Videotex Interworking protocol. This implementation, conforming to CCITT and CEPT recommendations, gives access to videotex networks both in Germany and the Netherlands. It works by making the command structures used by the various national videotex networks more uniform, or at least mutually "acceptable".

This is the first network-to-network implementation of Videotex Interworking (the Btx — Teletel (France) gateway was based on an additional access point, and will probably never be launched in its present form primarily because of political problems on both sides of the border).

IBM's Commitment to Videotex

IBM has seized centre-stage as a videotex proselytiser. In well orchestrated presentations in the US, IBM executives re-emphasised their company's commitment to videotex as a "mainstream" business product. This fervour may be revealing, since estimates are that IBM has not yet scored any notable videotex success. Although the company does not reveal the names of its clients, it is believed to have fewer than 10 active videotex customers.

IBM wants to see more terminals (presumably from any manufacturer) installed, since the availability of such terminals will develop an audience of universal users. This audience in turn will create a need for more central processing units (eg. IBM host systems).

800 Hooked on TD 4000s

Panasonic in the UK is running a private videotex system. Accessible to Panasonic's branches, salesforce and dealers, the service supplies technical bulletins, faults guides and repair details, 24 hours a day. Access to the company's IBM mainframe is also available for spare part ordering with immediate production of invoices, account information, invoice listings, order maintenance, company sales enquiries, etc. According to Panasonic, spare part ordering shows the greatest amount of usage, with 48% of all accesses. They are received via videotex terminals and automatically processed by computer.

Competition for Prestel

Timefame, previously Information Provider (IP) on the British Prestel service, is readying its Epnitex service for launch. Competing with Prestel, Timefame's Epnitex service is designed for both business and home users and is accessible via Prestel terminals. Data will be transmitted via British Telecom's V-PAD packet switched network.

Around 40 IPs are expected within three months of launching, covering such areas as law, weather, agriculture, news, downloading, education, messaging with an open forum, E-Mail, company databases and teleshopping — including Harrods, a large well known department store in the UK.

Users will pay a single, annual fee, covering all costs (communications and frame fees included). Market research has shown user demand for this fee structure. Education and home services will cost £125 per year, students £75 per year; business users £300 per year. IPs will pay £4000 per year including 300 pages. Home users will be restricted to usage after 6 pm only.

Dutch Videotex Association Sets the Trend

The Dutch Videotex Industry Association (VNVI) has made a radical opening to the information industry as a whole. Members now include information providers and databases of both videotex and ASCII online industries, as well as CD-ROM and CD-I suppliers. Now named VNVI (Dutch Association of Information Providers), it has also become the Dutch chapter of the US Information Industry Association (IIA).

Other associations are also moving in the same direction. This is the case with the French Videotex Industry Association, Aftel. Even the International Videotex Industry Association (IVIA) itself is working on merging with ASCII organisations, under the impulse of IVIA's new president, Georges Nahon, director of Intelmatique (France). Discussions are now under way with the EC.

Japan Studies Phone Book Program

Nippon Telephone & Telegraph (NTT) is actively studying the possibility of developing an electronic phone directory program with free terminal distribution. Unofficial meetings with French telecommunications authorities have recently taken place. NTT's initial objective is to evaluate the profitability of such a program on a Japanese scale, where the majority of users are business users. Profitability, either through an increase in telecommunications traffic or through advertisements, is now a major factor considering NTT's deregulation last year. NTT is proceeding with care on a social level as well, thoughtful of the implications for telephone operators.

Growth in Telebanking, Drop in Banks

Nearly 25% more Americans use telebanking systems today than a year ago, according to an annual survey of US home and business on-line banking in January. In all, an estimated 99,621 customers have signed up for telebanking, compared to 81,018 a year ago. The number of institutions offering computer-accessed personal and small business banking has slipped a bit: 31 organisations run trial or commercial systems now compared to 33 institutions a year ago.

Clearly, telebanking growth has been far below the optimistic levels envisioned by industry promoters. As one insider points out, the industry should be growing at a multifold rate to be considered a success.

Videotex to Monitor Health

The Institute for Futuristic Health Care Delivery (US) will use videotex technology to monitor the health of 100 diabetics and 100 healthy women in their homes. Test participants will be loaned Videotex decoders and colour monitors to access the database at the Hermann Hospital in Houston.

The videotex system, called the "Hermann Connection" has seven sections. Electronic mail is the most dynamic, allowing participants to pose questions to physicians, nurses, dieticians or pharmacists at the Hermann Hospital. Participants will be able to communicate with each other via E- Mail. The Daily Health Log lets users record, on set/special forms, information about exercise, food intake and medicines. The Analysis for Health Information program reviews diets for nutrients, calculates energy burned during exercise and tracks health measurements such as heart rate and blood pressure. A Word Search section steers users to resources for specific health information. A Health Encyclopedia contains general information on drugs, exercise, stress management and nutrition. Current health topics, recipes and notices of health lectures are in the Weekly Health Letter. And an on-line glossary lists health terms.

BBC News on Minitel

The BBC's worldwide news is starting a service on the French Teletel system, the largest videotex network in the world with 2 million Minitel terminals. The news service will bring pages of British and world news, backed by all the resources of the BBC News Department, to the users of Minitel.

A complete English language service on Teletel will support the BBC news providing sport and financial news, features, entertainment and weather, and travel information. This BBC English language service on Minitel is based on providing a large selection of pages from BBC CEEFAX, the world's first broadcast teletext service.

Financial news includes pages of the London Stock Exchange prices and pages of international money exchange rates and financial indexes directly from computers in the City of London.

Hotel Directory

Murdoch Magazines will launch "Murdoch Travel Systems" (MTS), an on-line, video hotel booking system for travel agents. MTS, the first interactive extension of the company's print publications, will merge the information resources of Murdoch's massive "Hotel Travel Index" directory with the reservations capabilities of Utell, a European-based hotel bookings system recently acquired by Murdoch's parent company.

The Utell relationship gives MTS the immediate ability to book rooms at 3300 hotels in business and vacation cities worldwide. Travel agents, corporate travel offices and other professional users will access the electronic information/reservation system through a special "Jaguar" workstation that Murdoch is developing; the unit will include an on-line system, videodisc and CD-ROM players and a laser printer. Murdoch currently has no plans to offer the information/reservation system to home users.

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

JON MARKS

Jon Marks

Jon Marks has been appointed as Sales Manager of Kurzweil Voice Recognition Systems for DBE Australia. Jon joins DBE after nine successful years at IBM.

Crusader Electronics

Crusader electronics has acquired the distribution rights to Cornell Dubilier equipment. Their range covers aluminium computer grade eletrolytics with screw terminals, and pc or axial leads.

George Brown Group

In the year just ended, the George Brown Group have reported a significant growth in business for Weller soldering and desoldering equipment. With an extended distribution of offices throughout Australia, the George Brown Group have placed the new Weller PPS (Pick-Place-Solder) prototyping SMD work station with several users. In addition, the servicing of Telecom with custom made Weller temperature controlled soldering irons has contributed to the increased business.

Elmeasco and Obiat

Elmeasco Instruments has added Obiat to its network of distributors. Obiat is located in Beaconsfield, NSW and is a stocking distributor for the range of Fluke, Coline, Topward, FW Bell and Aaron products. Their telephone number is: (02) 698-4776.

Concept Investment

The West Australian based Concept Investments has bought a major interest in Perth based keyboard and computer training company Edcom. The acquisition is the first venture undertaken by Concept Investments, which was established late last year to finance, market and develop computer based software ventures both in Australia and overseas.

Daniel Kwok

Mr Daniel Kwok has been appointed general manager of a newly formed Australian subsidiary of Crosby Associates International (CAI).

CAI is an American-based quality management consulting firm which operates through the US, Canada, the UK, Europe and South-East Asia. It will operate in Australia as Crosby Associates Australasia.

Mr Kwok has transferred from CAI's office in Singapore.

Rifa

Long-established electronics distributor, RIFA, is now in the final stages of a comprehensive 18-month long review of its sales and marketing strategy.

RIFI's rang includes semiconductors, power supplies and capacitors: AKM semi-conductors, EVOX capacitors and mains filters; BULGIN mains filters, IEC connectors, barrier strips and battery and fuse holders; EDDYSTONE die cast boxes; and DALE resistors.

Swintek

Bob Detheridge, has joined Amber Technology.

Previously with Magnetech and the John Barry Group, Bob will concentrate on product areas associated with video and film. These include the CINE 60 range of batteries, chargers, sun-guns and light kits, and Swintek communication products, plus some exciting new products later in the year.

BRIEN HILLS

Hills

Mr Brien Hills has been appointed General Manager of Material Management Services, a wholly owned subsidiary of the WA headquartered Monadelphous Group. He was previously General Manager of Monadelphous' New Zealand operations.

ICL

Chris Wilkinson has decided to stand down as Manaaging Director of ICL for personal reasons. Richard Livesey-Haworth is the new Managing Director.

UMD

Unique Micro Design (UMD) have moved into new and larger premises in Boronia, as a result of expansion of their electronic design and manufacturing services. UMD are now located at Unit 2/23 Wadhurst Drive, Boronia, Vic. 3155 (03) 887-1022, Fax (03) 887-0734.

NSD

Following the acquisition of Fairchild by National Semiconductor Corporation, NSD Australia has been appointed national distributor of the Fairchild range of semiconductors. Fairchild products are now available from NSD Australia include the FAST And FACT logic families, linear and discrete range, including Op-Amps, Voltage Regulators, Zener Diodes, Signal Diodes, Transistors, and many more.

Dougall

Bill Dougall has been appointed General Manager for Hagemeyer (Australasia) JVC Products Division, Mr Dougall was previously National Marketing Manager and has been with the company for 4 years.

Cooper

Ms Hannah Watterson has joined Sydney-based public relations company Cooper Associates as a Senior Consultant. Cooper Associates specialises in the corporate and high technology fields and Ms Watterson will service clients' public relations needs as well as manage the company's Corporate Publications Division. She is a qualified journalist with over 10 years experience in journalism and public relations. Ms Watterson was most recently editdor of Computer Graphics Technology, a specialist trade magazine published by Business Press International.

Tektronix

Tektronix has acquired SIGnology, Inc., a three-year-old Campbell, Californian company whch designs and manfucturers Fourier analysis systems. SIGnology, was founded in 1984. The founding team members have extensive experience in the design of Fourier analysis systems.

Les Newberry

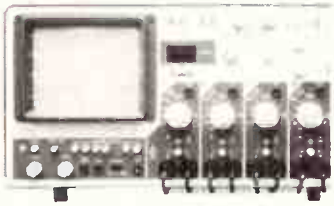
Hi-Phon

Hi-Phon Distributors have recently made new appointments to their team. Malcolm McIntosh joined the consumer division towards the end of last year as NSW state manager. Prior to joining Hi-Phon he was involved in the selling of Fujitsu car audio, and before that, with Vanfi.

In the Professional Division, Les Newberry has been appointed Victorian state manager for professional audio products, following the departure of Ossie Palmer. Les joins Hi-Phon from Quinto Communications.

Anitech

New appointments have recently been made in Anitech's expanding Controls Division. Phil Lonsdale comes in as NSW Sales Manager, and Greg Creed has been promoted to Vic Sales Manager. Phil joins Anitech with considerable experience in control products, having previously been with Erwin Sick where he specialised in photoelectric products. Before that he was NSW Sales Manager with Bellco Controls.



BWD

BWD Precision Instruments, have extended the warranty period on all their equipment from 1 to 2 years. The company says it will also be releasing three new oscilloscopes during 1988.

Elmeasco

In early January Elmeasco Instruments moved to a new location at 18 Hilly Street, Mortlake. The new location features a larger warehouse, larger office and administration areas and is some 400 metres from the original premises. The phone number remains (02) 736-2888, with new Fax (02) 736-3005.

ACL

Associated Calibration Laboratories (ACL) of East Doncaster in Melbourne have appointed Len Heyward as Managing Direcotr.

Heyward has had extensive technical experience overseas in the aviation field and more recently in marketing and sales of specialised communications and test equipment in Australia.

The outgoing Managing Director, Peter Williams, said that Mr Heyward's vast experience and knowledge of the electronic field and familiarity with Government policies will allow continued growth for the Company in the years ahead.

L Heyward

Peter Williams will be retained as consultant and plans to spend several years ocean cruising.

Assembler Acquired

CSSA Australia, the cable assembly manufacturer, has acquired the circuit board assembly business of Sanders Electronics and has moved to new larger premises in Parramatta in Sydney.

The acquisition of the Sanders business was completed in the closing stages of 1987 and both companies are now housed under one roof in Parramatta.

CSSC managing director, Mr David Hiscock welcomed the new division as an extension of the manufacturing facilities already provided by the company.

Mr Theo Sanders has joined CSSC on a five-year contract and all ten staff were offered employment at the new premises.

The new premises is located at Unit 3, 1 River Road West, Parramatta (02) 689-3699.

PETER MARMACH

Setec expands production facilities

Switch-mode manufacturer Setec has begun an expansion program that will provide increased administrative, design and production space. The commission of two HP CAD systems along with new dedicated process assembly lines allow the company to efficiently design and produce export volume of product. The company's production manager, Mr Peter Marmach feels the expansion program is integral for Setec's growth in the export market. We need to streamline our design and assembly processes and cut costs in these areas to remain competitive. Setec's innovative approach to manufacturing is currently attracting strong interest from both on-shore and offshore multi-nationals.

This month's kilohertz comment reports on the recent survey into VOA broadcasts.

Kilohertz Comment

VOA Survey Released

Late last year Warren Schor of the VOA Washington office visited the South Pacific to survey the reception of signals in this area and to visit the monitors in Australia and New Zealand. During his period here special test transmissions were also carried out. As well as visiting and surveying reception in Suva, Port Moresby and Kolonia and Ponapei in Micronesia he visited the monitors at Invercargill, Sydney, Canberra and Perth. In New Zealand he looked at reception in Wellington and Christchurch and in Australia at reception in Kalgoorlie, Port Augusta, Parkes, Cooktown and Broken Hill.

Schor said he felt that an earlier evening transmission to this area would prove most successful, as against the two present transmissions at 2200 UTC in the morning and 1100 UTC in the evening.

The possibilities of stations in the South Pacific relaying VOA programmes was also considered, with particular reference to private stations in Guam and Saipan. A comparison of other signals in the area showed that, on the whole, Radio Australia dominated reception in the South Pacific Islands. For instance, in Suva, Radio Australia was the dominant signal for both morning and evening reception followed by Radio Japan, Radio Moscow and KTWR Guam, while in the evenings the BBC and VOA also appeared on the band. In the Central Pacific in the mornings KSDA Guam is the dominant signal and in the evening Radio Japan, while Radio Australia was not listed in the top five signals noted in the Micronesia area.

From this survey, which lasted nearly two months, it became obvious that listeners in the South Pacific would like VOA transmissions beamed at a more suitable time. At the present time the VOA broadcasts are 2200-2400 UTC on 151-85 kHz and 17740 kHz and 1100-1300 UTC on 6100, 11715 and 15425 kHz, which are primary signals for this area.

Sunspots Increase

Shortwave listeners are aware of the continuing increase in the sunspot count. This is further emphasised by the use of the higher frequencies by international broadcasters. For the first time for several years the 11 metre band is now scheduled to be used while the 13 metre band is becoming very active.

The spreading of the stations from the lower to the higher frequencies means less interference and greater use of the bands which are allocated, but this is only possible during high sunspot periods. This year the sunspot count is expected to reach its peak of around 150 spots. This would be the top of the 11 year cycle and after that in the early 1990s the spots will, gradually reduce. In a further seven years they will reach the low point in the 11 year cycle.

Two broadcasters using the 11 metre band are Radio Norway on 25730 kHz from 1200 UTC, and Radio Nederland. In the 13 metre band some interesting signals from Africa have been noted including Radio Japan through Gabon on 21695 kHz at 0700 UTC. Radio Nederland relays through Madagascar on 21485 kHz 0700-0825 UTC. Deutsche Welle relays through Kigali on 21650 kHz 0900-0950 UTC.

Kilohertz Comment

AUSTRIA: The Austrian Radio popular Shortwave Panorama Session is now heard on Sunday at 0815 UTC on 15415 kHz. The 15 minute programme for shortwave listeners includes information from Glen Houser in the United States. The English transmission is heard for Australia at 0830-0900 UTC, while the repeat broadcast on 17860 kHz is heard 1100-1200 UTC.

GREECE: Broadcasts from Athens to Australia in English are at 0840-0850 UTC on 9855 and 15630 kHz. The complete transmission 0800-0850 UTC and the balance of the broadcast is in Greek. An earlier transmission 0300-0350 UTC received on 7430, 9359 and 9420 kHz includes English 0340-0350 UTC. The English broadcasts are daily and consist of 10 minute news bulletins.

NEW ZEALAND: The Minister of Foreign Affairs announced recently that he is proposing the Government spend NZ$3-4 million on the upgrading of the Shortwave Service and hoped this would be put into effect this year. It is 40 years on September 26 since Radio New Zealand first commenced its shortwave transmissions. The proposal is yet to be approved by Government but it seems possible the listeners in Australia and the South Pacific will soon enjoy better reception of Radio New Zealand.

SAIPAN: Radio KYOI, which is now operated by the Christian Science Monitor, is asking for any significant reception reports be sent to PO Box 860, Boston, Massachusetts, USA 02123. Broadcasts have been heard on 17780 with this announcement at 0545 UTC. The Station is now announcing as "All Hit KYOI" and has revised its programme from the former "Super rock" image. This month KYOI expects to relay broadcasts of news and other information direct from the Boston studios via satellite.

SPAIN: Radio Exterior Espania Madrid is now having its programmes relayed by Radio Beijing. The broadcasts are in Spanish directed to The Philippines from 1000-1050 UTC. 7165 kHz is the frequency on which we have noted these broadcasts.

SWITZERLAND: Swiss Radio International Berne is very well received in the new 13 MHz band using 13685 kHz for a broadcast in English 1530-1600 UTC. Swiss Radio International programmes are relayed by Radio Beijing on 11695 and 15135 between 1330 and 1400 UTC.

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 quoted are in UTC (GMT), which is 10 hours behind Australian Eastern Standard Time.

COMING EVENTS

MARCH

The 10th 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 Illoura Plaza 424 St Kilda Road, Melbourne, Vic 3004. Tel 267-4500.

APRIL

The International Workshop on Robot Control, will be held over April 11-12 in Oxford, UK. For further information contact the Conference Services, Institution of Engineers, Savoy Place, London WC2 ROBL, UK.

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

The Ninth International Conference on non-destructive evaluation in the nuclear industry: Technical Department Marketing, ASM International, Metals Park, Ohio 44073, USA.

The 18th meeting of the Intelsat Signatories will take place on Hamilton Island this month. The meeting will be hosted by OTC and more then 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 potential for Australian industries in the commercialisation of space. Contact the Secretariat UniQuest Limited University of Queensland St Lucia Qld, Australia 4067. Tel (07) 377-2899.

MAY

An International Conference on Environmental Radio-Activity in the Mediterranean area. Contact Mr Alejo Vidal-Quadras Roca, Servicio de Las Radiaciones, Universidad Autonoma De Barcelona, E-08193 Bellaterra, Spain.

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

The Australian Bicentennial International Congress in Mechanical Engineering (Mech 88) will host a Conference on Space Engineering will be held in Brisbane over May 8-13. To visit or participate contact the Institution of Engineers, Australia, Conference Manager, Mech 88 Conference, 11 National Circuit, Barton, ACT 2600. Telex: AA62758.

The first Australian FORTH Symposium will be held at the New South Wales University of Technology over May 19-20. A keynote event will be the address by Charles Moore, the inventor of the FORTH microprocessing technology. Contact Jose Alfonso. UTS, PO Box 123, Broadway, NSW 2007. Phone (02) 2-0930.

JUNE

The first Australian Audio-Video Fair will be held at Wesly College, Melbourne, from 30 June to 3 July. Anyone wanting to exhibit or attend should contact Barnes Exhibition Management, (03) 211-3777, 3026.

JULY

The 10th Perth Electronics Show will be held at Claremont Perth over July 13-17. Anyone wishing to exhibit or attend should contact the Manager's Office, 94 Hat Street, Subiaco, WA 2008. Phone (09) 382-3122.

COMDEX Australia's National and International Computer and Communications Exhibition and Conference will be held in the Darling Harbour area of Sydney from 26-28 July. Potential visitors and exhibitors should ring (02) 959-5555.

AUGUST

The 3rd Regional Convention of the Melbourne Audio Engineering Convention will be held at the Melbourne Hilton over August 16-18. The three day programme of papers and workshops will be accompanied by an extensive exhibition of audio products. Contact Brian Horman, PO Box 131, GPO South Melbourne 3205. (03) 329-0162.

SEPTEMBER

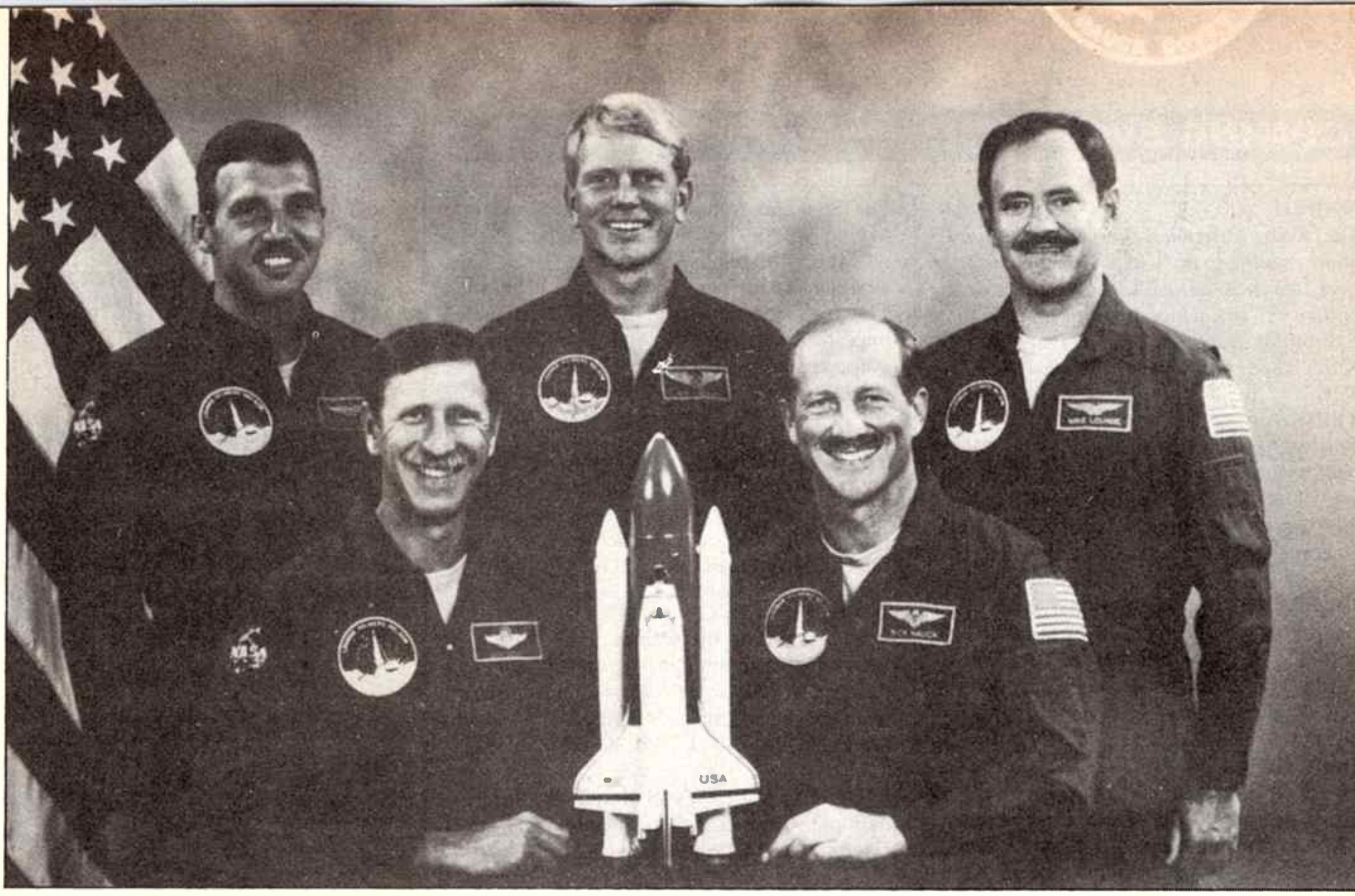
The ANZAAS Centennary Congress will be held over 2-6 September, 1988 at Sydney University. Enquiries should be addressed to Mr B. O'Bourke, Organising Secretary 1988 ANZAAS Centennary Congress 118 Darlinghurst Road. University of Sydney, NSW 2006. Tel (02) 692-4356.

OCTOBER

The Australian Computing Exhibition will be held at Darling Harbour on September 20-22. Contact Michael Fleur (02) 264-1266.

NOVEMBER

The International Robot Show featuring Artificial intelligence systems, automated guided vehicles, coating equipment, computer-integrated manufacturing equipment and many other items of cybernetic interest will be held from 7-10 November. There will 60 estimated exhibitors and anyone wishing to participate should contact Australian Exhibition services 424 St Kilda Road, Melbourne, Vic 3004. Tel (03) 267-4500.



The crew of the new shuttle, from left to right; Dave Allmers, Richard Carey, George Nelson, Frederick Hauck, and John Lounge.

COUNTING DOWN TO DISCOVERY

Kathryn M. Doolan

Nineteen eighty-eight will see the first American manned spaceflight since the demise of the Challenger, over two years ago. In that time the American space program has been shown to the world as a politically dominated program rotten to the core, while the Soviet program has made major steps towards the cherished goal of landing cosmonauts on Mars.

Currently NASA is nominating the 4th of August as the date for the launch of the new shuttle named Discovery. The mission will be called STS26. Barring technical mishaps Discovery will be launched from the Kennedy Space Centre 31 months after Challenger. However, there is every reason to doubt the launch date will be achieved, since NASA has already postponed the event numerous times.

The five man crew, all space flight veterans, is commanded by Frederick (Rick) Hauck, who has flown on STS7 and also commanded the spectacular 51A satellite retrieval mission. Piloting the Discovery will be Richard Covey who flew on 51I (the flight that launched Aussat One). Mission Specialists will be John (Mike) Lounge, who flew with Covey on 51I, Dale Hilmers, a participant on the Department of Defence's 51J mission. George Nelson who has flown twice on 41C and 61C has the honor of being the first American to fly two (successful) missions in a row. If any emergency arises that will need Extra Vehicular Activity, Hilmers and Nelson have been named as the crew members to go 'space walking'.

The primary payload of the four day mission will be the deployment of the third Tracking and Data Relay Satellite (TRDS). The first TDRS was deployed on STS6 in 1983, and the second one was destroyed on mission 51L in January 1986. Manufactured by TRW, TDRS-C will provide a crucial role in Space-to-Earth communication for NASA in years to come.

Once the three TRD satellites are in place, NASA's Space Tracking and Data network will be phased out. Three of the 12 tracking stations in use have been transferred to the Deep Space Network (including Tidbinbilla in the ACT), those three stations will be used for planetary and solar system exploration. The other nine stations will eventually close down or be transferred to other US government agencies.

The concept of using satellites for its own communications purposes (ground to ground and ground to space) was developed by NASA in the early 70s, following studies that suggested a system of communication satellites could be operated from a single ground station. In the budget-cutting that went on at NASA, this was one of the ways in which money could be saved in the long run.

Once TDRS is deployed from Discovery, it will undergo a series of tests and then will be moved to its geosynchronous location over the Pacific Ocean, south of

Hawaii. A fourth TRDS will be launched from the Shuttle in late 1989 or early 1990.

Other experiments to be conducted during Discovery's flight will concentrate on the new flight hardware installed on the shuttle. On the flight deck new computers have been installed, steering controls for landing have been modified and new brakes have been included, after landing difficulties encountered in 1985.

Modifications

One problem area on the Space Shuttle has always been its main engine systems. It was always expected that if anything went wrong with the Shuttle the main engines would be responsible. In the time since Challenger, modifications have been carried out and recently one engine was fired for a total of 6000 seconds, more than is required during flight.

Improvements have also been made to the cause of the Challenger's demise — the Solid Rocket Boosters (SRB). In its report the Rogers Commission urged NASA to re-design the infamous 'O' rings and judging by recent reports, the whole joint has thoroughly changed. Some of the improvements include: heaters to be used to maintain joint temperature of 75 degrees Fahrenheit; an additional 'O' ring seal; and weather seals to keep out water.

Most of the SRB testing has shown the new seal to work. However, just before Christmas in one test firing, the end of an SRB nozzle was blown off. According to NASA this happened due to excess pressure placed on the joint by engineers, to test what would happen if such an event occured in flight. NASA officials say this was only a hypothetical test and would not happen in actual flight conditions.

If all goes well Discovery will land at Edwards Air Force base on the 8th of August. NASA hopes that it can launch STS27 by December 1988. STS27 will be the first in an increasing series of classified missions flown for the US Department of Defence, which will see a scaling down of open scientific flights which have paid rich dividends in the past.

Last Ditch Stand

Before any of this happens, Discovery will have to be launched. The interest in this flight will be immense; NASA will not be able to complain of lack of interest on the part of the media as it was prone to do before the Challenger incident. STS26 will be one of the most carefully observed space flights ever, and it will be crucial for NASA that nothing happens to jeopardise the crew or shuttle. If another accident takes place, the shuttle program may cease to exist along with NASA itself. However, a successful flight of STS26 will go a long way to convincing the American public that the shuttle does belong in space and not on the floor of the Atlantic Ocean where the spirit of NASA has been sitting since January 1986. ●

Kathryn Doolan is with the Space Association of Australia

Space station agreement

More pressure on NASA to make the shuttle work has come from the recent agreement between Europe and US on the operation of Columbus, Europe's contribution to the US's space station. The agreement follows 18 months of discussions, and paves the way for an intergovernment agreement on the space station.

The agreement details the amount of power that the space station will supply to Europe's laboratory attached to the main station, what storage facilities there will be, the time allowed for experiments, and access to transport to and from the station.

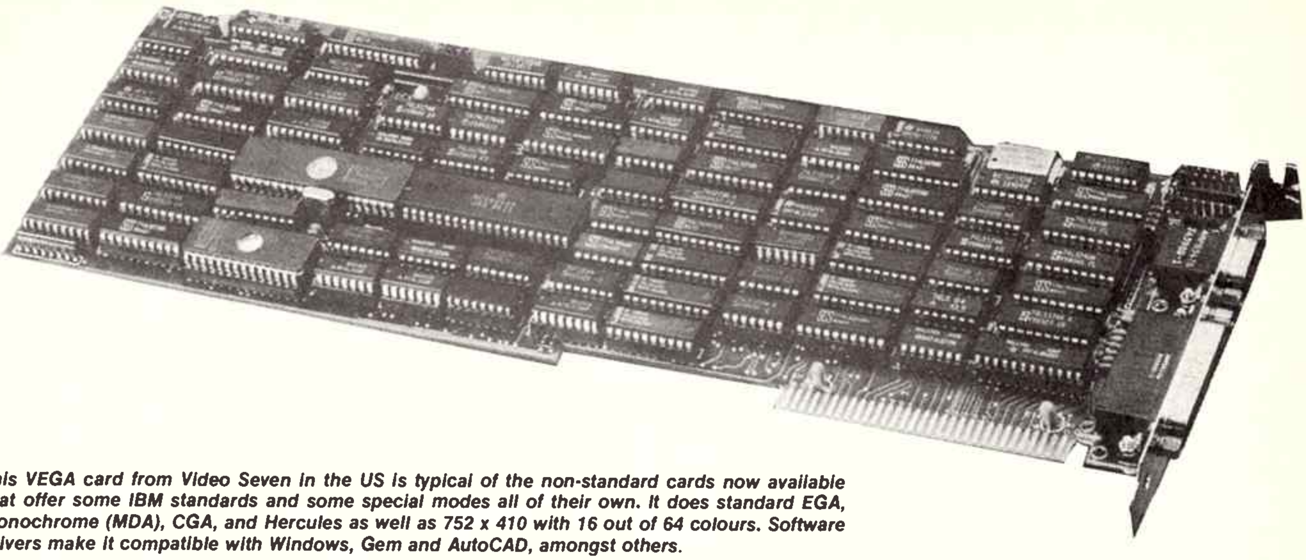
Columbus consists of a laboratory attached to the main station, a separate orbiting laboratory that astronauts would visit to change experiments, and a remote-sensing platform, orbiting over the poles and called the polar platform. Australian scientists have taken particular interest in the possible ramifications of this device, since it would be the only part of the station that will penetrate to southern latitudes.

British Aerospace hopes to be the main contractor for the polar platform. However, if the British government decides not to participate in Columbus, Europe could build a polar platform without BAe's involvement. Philip Goldsmith, the ESA's director of earth observation and microgravity, says that the French have put forwad an alternative proposal. It is based on a design of the platform for Spot, the French commercial satellite, and would not be as large as the initial concept.

Besides waiting for Britain's decision on Columbus, Goldsmith wants to hear whether the British government will back Europe's plans for ERS2, a remote-sensing satellite that will carry infrared and microwave detectors of observing ice and the oceans. Data from ERS satellites will be important for global models of the climate.

The ESA is planning two ERS satellites. ERS1 will be launched in 1990, and is under construction now. ERS2 is planned, nominally, for 1993. Polar platforms to be launched by NASA and the ESA, in 1995 and 1997 respectively, will also carry microwave and infrared detectors.

ERS1 carries a significant Australian experiment on board and disruption of its schedule would lay havoc with Australian space plans.



This VEGA card from Video Seven in the US is typical of the non-standard cards now available that offer some IBM standards and some special modes all of their own. It does standard EGA, Monochrome (MDA), CGA, and Hercules as well as 752 x 410 with 16 out of 64 colours. Software drivers make it compatible with Windows, Gem and AutoCAD, amongst others.

GRAPHICS CARDS

The second in an occasional series by ETI staff that looks at the hardware of the ubiquitous IBM-PC/XT/AT and clones. This month it's the turn of the graphics card.

When the IBM-PC was introduced back in 1981, it was unique in having its graphics on a separate board. Previously, the handling of graphics had been considered such an intimate part of the design of a computer that it was always contained on the motherboard. Even when the user had a choice of video standard, this was generally taken care of in different parts of the on board circuitry.

The concept that drives the video on a PC is quite different. (For PC, please read IBM-PC, or the XT version or the AT version whether made by IBM or some other vendor. Compaq *et* al may frown, but we can't be pedantic). From the ground up the PC was designed around the idea that the video section would be on a totally separate board, specifically to allow a multitude of different standards to be developed.

When the first PC was released IBM had two different video adaptors on hand. The first was the monochrome adaptor, the other the colour graphics adaptor, coloquially known as a CGA. For reasons that will be apparent shortly, IBM subsequently released an improved version, called the EGA or enhanced graphics adaptor. IBM also released a professional graphics adaptor (PGA) which, as its name suggests, is for high-end professional use.

Of course, it's no secret that IBM has not had the field to itself. Indeed, for every factory around the world making clones of the IBM-PC, there are a hundred making copies of the various add-on boards that can be slotted into them. This is especially true of the graphics cards. Nor have the clone makers been content to simply reproduce IBM's standards. Today cards are available in all sorts of congigurations, some considerably more sophisticated that the original. Indeed, it's not uncommon to find graphics adaptors for the PC that have more computing power on board than the PC itself.

Monochrome Adaptor

The absolute minimum required of a PC's video system is the ability to write text on a screen. This is what the monochrome adaptor does. It was designed by IBM to be a two-colour, text-only adaptor to allow the computer to be hooked up to a variety of video devices, like a TV set or monitor.

The monochrome adaptor prints text characters (the full 128-character IBM ASCII set) on the screen in 25 rows, each either 40 or 80 characters long. The 80 character mode is by far the most popular. The 40-character mode was introduced specifically for the use of signals going to TVs, which are degraded by the products of modulation and demodulation. When the PC was introduced many people still used computers in this fashion.

The monochrome adaptor requires 4K of memory in order to function. Since 80 characters x 25 lines = 2000 characters on the screen, it is apparent that each position requires two bytes to store it. One byte holds the actual character to be displayed, the other is known as the 'attribute' byte. The attribute of a character refers to the background on which the character is to appear. It can be set to be invisible, reversed, underlined, normal (of course) and blinking, plus a combination of these.

CGA

The CGA standard is the cheapest and easiest way of getting colour from the PC. It can operate in either text or graphics mode. In the text mode it functions much like the monochrome card, except that attributes allow the selection of foreground and background colour as well.

In the graphics mode the software has access to every pixel on the screen. The exact number of pixels can be varied, from 320 to 640 dots across the screen and 200 dots vertically, ie, 128,000 distinct dots. The 320-dot standard is called mode 4, the 640-dot standard is mode 6. There is a trade-off between the resolution, ie, the number of dots, and the number of colours that can be displayed. If only 320 dots are displayed, each can be any of four out of 16 possible colours. In the 640-dot mode, the IBM PC is really taxing its memory resources, and so only two colours, ie, monochrome, are available.

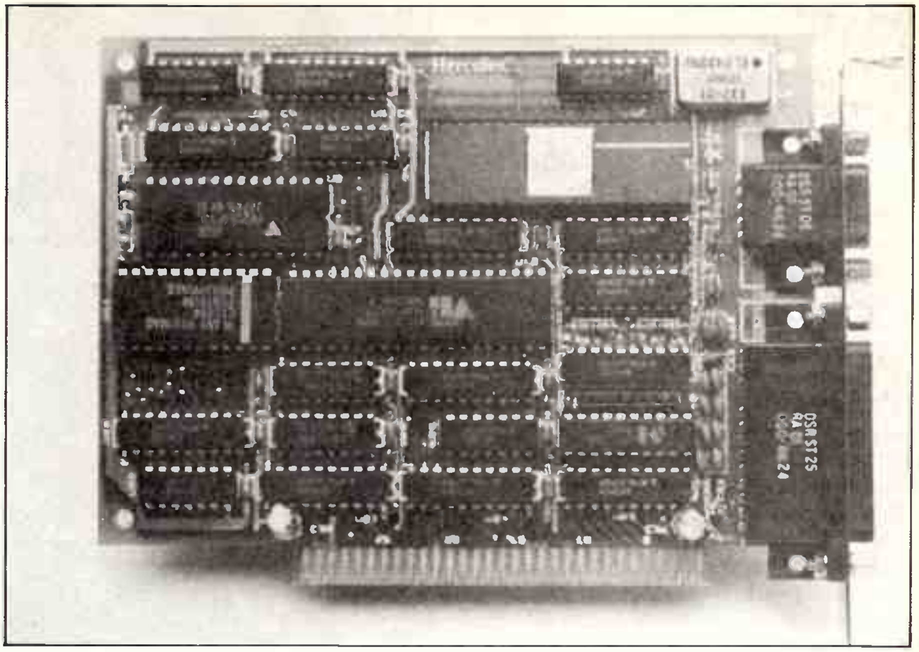
The CGA card requires 16K of memory, four times as much as the monochrome card. In mode 4, the memory is divided into two banks. The first holds information on the even-numbered scan lines, and the second holds information on the odd-numbered lines. The two banks of memory can be displayed alternately to produce an interlaced screen (see box).

When it's operating in the text modes, a CGA card only requires 4K per screen, so it's possible to store four screens at the same time. These screens are known as 'display pages'. While only one page is visible at any one time, any of the four can be manipulated by the PC's processor. This makes it possible to change a page before it's displayed. In fact, one page can be changed while the user is looking at another, a facility that has obvious implications for animation, and other sorts of clever programming.

EGA

You may be tempted, on reading all this, to wonder whether IBM sold any monochrome adaptors, given that the CGA card appears to be able to do everything the monochrome card can do, and a lot more. The answer, unfortunately, is that most of the machines IBM sold, and probably most sold by other vendors as well, have gone out with the monochrome card. The typical IBM machine is used in some text manipulation role for most of its life, and in that role, the resolution of the CGA card is just too coarse for serious work.

As a consequence, IBM began to look at ways of increasing the resolution of the screen, and retaining the colours of the CGA while equalling or exceeding the definition of the monochrome card. The answer was the enhanced graphics adaptor. The EGA supports all the CGA modes as well as introducing four of its own. The first two modes give more colour at similar resolutions to those of the CGA. The third, mode 15, retains the horizontal resolution, while increasing the number of lines up to 350. Mode 16 does it all together. It offers 640 x 350 with 64 colours.



The Hercules card has become an industry standard format, even without the sanction of big blue. This card has a centronics port as well. Courtesy of Tech Pacific.

The amount of memory required to run the EGA card varies with the selected mode. Mode 13 requires 32K, mode 14 needs 64K, mode 15 448K, even though it only works in monochrome. Mode 16, with its 64 colours, eats up a massive 1.334 megs of memory.

Just how this memory works is enormously complicated because it requires more memory in mode 15 and 16 than is available in the PC's address space. This is the 64K sized A bank. This means that the working memory has to be switched in and out of the available space as needed. In this way, the PC can gain access to whatever part of the EGA memory it requires.

The circuitry to do this is held on the EGA card. It automatically reconfigures the memory to the required video mode and the amount of memory available, and then bounces it in and out of the working address space as required. You may get the impression that the software to control this is complex, which explains why not every program you buy will run on the EGA. The EGA is an excellent semi-professional standard, but it has only been achieved at the price of considerable complexity.

Hercules

The Hercules Card was developed for the same reason as the EGA card. However, instead of trying to be all things to all people, like the EGA, the Hercules card uncompromisingly goes after resolution. Arguing that most users require good resolution before they require colour, they provided no colour capacity, just 720 horizon-

Interleaving

The IBM PC uses interleaving of the scan line in its graphics modes to minimise flicker. To understand what this means, remember that the picture is painted on the screen by the passage of an electron beam over phosphors on the inside of the screen. This beam is controlled by deflection plates on the tube, which are capable of bending the beam as the electrons travel from the electron gun to the screen. These plates are used to move the beam very rapidly from side to side, and rather more slowly up and down. The result is that the beam paints a series of lines across the screen from side to side, starting at the top and working down to the bottom.

The picture is painted by modulating the beam, ie, altering its intensity so that it causes a different degree of illumination of the phosphors at the point where it hits them. In the case of monochrome display terminal, modulation would be binary, ie, fully on and fully off, since the picture is made up of a series of dots without any shades of grey.

It was discovered, early in the history of TV, that while this is a perfectly practical way to make a TV, it is less practical to make it all happen so fast that it completely fools the eye. In fact, early non-interleaved TV seemed to flicker rather badly as each frame was built up laboriously from the top to the bottom. The answer was to double the frame rate, ie, double the rate at which the electron beam went from top to bottom, but to do so by leaving out half the lines. The idea was then to go back to the beginning and paint in the missing lines on the second pass. The result: a more or less flicker free picture.

tal pixels and 348 scan lines.

720 x 348 = 250, 560 pixels, and so a similar number of bits. Dividing by eight gives 31,320 bytes, which fits nicely into 32K of memory. This 32K is divided into four banks, which correspond to four frames, each of which contains 87 lines. These lines are interleaved in the normal fashion to display the 348 lines of the complete screen in a flicker free fashion.

PGA

The last of the IBM standards is the professional graphics adaptor, a two-board add-on that turns your ordinary old PC into a professional-level graphics workstation. Resolution is 640 x 480, with 256 colours available out of 4096. The screen is not interleaved. Instead the frame rate is increased to 60 Hz to get rid of flicker. A special monitor is required with a 25 MHz bandwidth to cope with this speed.

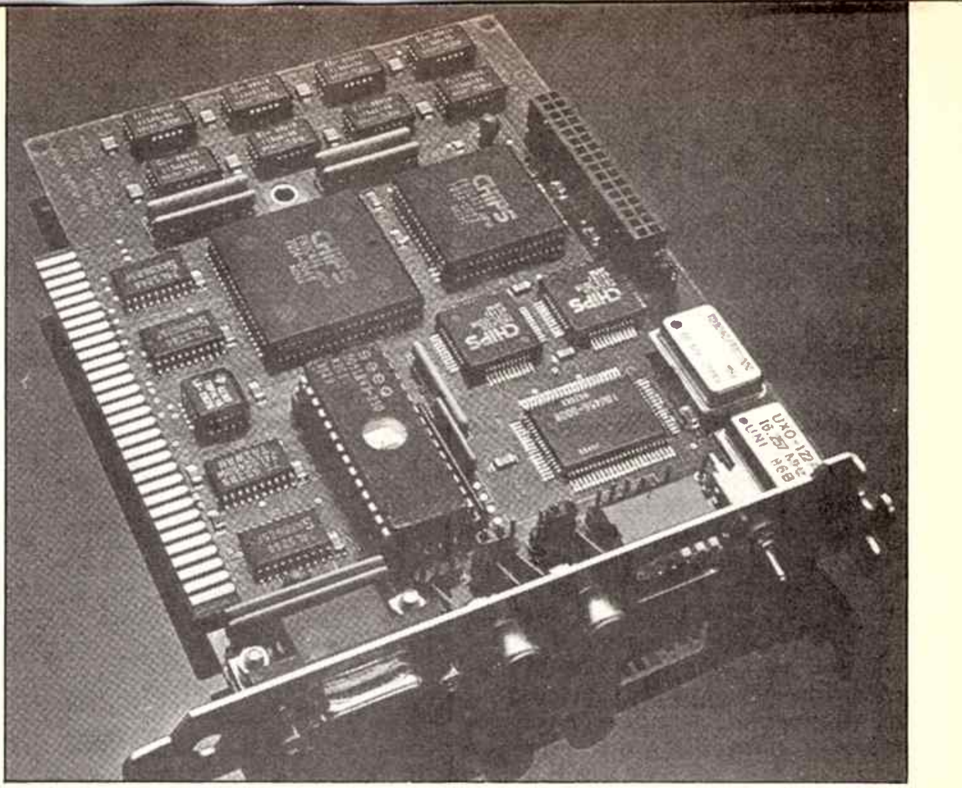
The power of the PGA is not really visible from a bald statement of its vital statics. The boards carry hardware based around an 8088 processor for extensive graphics manipulation; drawing, rotating, translating, scaling, vector and polygon drawing and so on. This frees the onboard software from some of the mundane tasks that are necessary when handling graphics.

Clones

This summation of graphics standards may leave you with the impression that the world of IBM-compatible graphics is nice and neat. In fact nothing could be further from the truth. There is a raft of clones, mixing and matching facilities, modes and standards according to their maker's perceptions of the market.

IBM itself combined the monochrome adaptor with a Centronics printer port. However, clone makers have gone much further. Typical combinations include monochrome and CGA, HEGA, which is Hercules and EGA and, predictably, all sorts of variations on the theme, with printer, games and mouse ports being firm favourites.

This doesn't include the non-standard modes available, which are even more numerous. The typical structure of such a card is to have a number of standard modes, plus some enhancements. For instance, EGA cards often have a special mode, sometimes as high as 1072 pixels across, which can be run on a high bandwidth monitor. These enhanced cards have the problem that without software nothing will run on them, so special drivers need to be included in the package to allow existing programs to make use of them. Typically, drivers are included for the famous industry standards like AutoCAD or Microsoft Windows.



The Everex Edge will generate 132 x 44 rows and look like a Hercules card to your software. It also has colour options: 320 x 200 with 16 colours or 640 x 200 with 4 colours. Courtesy Everex Australia.

PS2

IBM itself no longer makes any of the PC variations, nor does it make any of the peripheral cards. Stocks of the last of the IBM-brand EGA and PGA cards are now disappearing off the shelves of IBM dealers in Australia, leaving the market wide open to the clone makers.

IBM has gone off into uncharted waters with the PS2, and the PS2 display adaptor. This is a single board that reconfigures itself according to the type of display in use. IBM has four, one monochrome and three colour of differing resolution that are especially designed for the PS2.

The new graphics cards have a completely different architecture from those that applied with the PC. The new generation monitors require an analogue input, so the card itself must do the work of turning the digital signals from the computer into analogue form.

However, they are completely backwards compatible, to the extent that all the video modes of the PC family have some relationship to PS2 graphics. They vary from 320 x 200 to 640 x 480, and then add in three new modes. On the PS2 you can choose 1024 x 768 with 16 out of a possible 256,000 colours, or have two pages of 640 x 480 resolution.

Unfortunately, the clone makers are having trouble turning out a decent clone of the PS2, so they have yet to flood the market with cheap imitations of Big Blue's product. That's unfortunate, because it means that it will be a while before ordinary mortals get amongst the dense pixels of the new generation video cards. ●

IBM's Video Modes

Mode	Colours	Resolution
0	2	40 characters
1	16	40 characters
2	2	80 characters
3	16	80 characters
4	4	320 dots
5	2	320 dots
6	2	640 dots
7	2	80 characters
8	16	160 dots
9	16	320 dots
10	4	640 dots
13	16	320 dots
14	16	640 dots
15	2	640 dots
16	64	640 dots
Herc	2	720 dots

This is a list of the principal modes of the IBM family. The first seven modes are used with CGA cards and standard RGB monitors. Mode 7 is the monochrome adaptor standard. Mode 7 and mode 15 both use a monochrome display with 350 lines, in contrast to the standard colour display which has only 200 lines. Modes 8, 9 and 10 belong to the PC Junior and are included here only for completeness. Modes 13 and 14 are used with the EGA card and a standard RGB monitor. Mode 16 requires a special enhanced display. Herc refers to the Hercules card which is not an IBM standard so does not have a number. However, it has become so popular that it is necessary to include it in this survey.

There are a few esoteric modes associated with the professional graphics adaptor, but we do not cover them in any detail.

FASTER THAN A SPEEDING STAMP

The penetration of data communications is revolutionising the post office. As personal and business communications depend less and less on old fashion letters. They depends more on facsimile, and other electronic services.

Tom King

Australia Post was created from the left overs of the old Post-Master-General's Department. Electronic communications went to Telecom Australia and Australia Post got the rest. Half a generation on, Australia Post is still struggling to define a role for itself. The answer seems to be in a host of new services, that depend very much on the latest in data communications technology.

Intelpost, one of three electronic mail services offered by Australia Post, uses facsimile technology to ensure two hour (courier-assisted) delivery of text and graphics within Australia and the "fastest possible delivery overseas".

Essentially a business service, Intelpost was introduced in February 1984. It is claimed to be the fastest mail service on earth . . . thanks to up-to-the-moment equipment and the Australia Post Express Courier Service. (Intelpost also links with compatible private fax machines anywhere in the world provided that direct dial facilities are available.) It can be used for business information exchange between Australia and over 60 countries. Qatar, Thailand and Fiji were the latest countries to come on-line. However, a few European countries including most eastern block nations still do not have business facsimile connections with Australia.

"Here in Australia we are being restricted by the electronic limitations of other countries," said Tim Quinn, Australia Post, Manager, Speed Services. "We are perhaps the most sophisticated country in the world when it comes to electronic mail technology. These days electronic mail experts from overseas come to Australia not to lecture to us but to learn from us," Mr Quinn said.

And with over 500 domestic Electronic Post Centres — from Thursday Island and Broome to George Town, Tasmania and Parliament House — where Australia Post fax facilities are available, it's understandable why our systems are being studied so closely. One of the statistics that awes most of the overseas experts is that Australia has the largest public fax network in the world. In addition, about 65 per cent of all private businesses use facsimile equipment on a routine basis.

New Features

Such equipment is likely to become more 'user friendly', lighter and probably less expensive in the future, believes Mr Quinn. Other trends anticipated are the use of more professional-appearing bond paper instead of thermal paper, faster transmission times, colour fax and more sophisticated features: automatic dialling and redialling, sequential transmission, greater resolution (256 dots per sq mm is expected), grey scale transmission (useful for photographic reproduction), security controls for confidential information, memory storage if the paper supply is exhausted, automatic size change for paper, and program controls to take advantage of lower telephone rates at night and weekends.

Improvements in the technology are predictable, at least in the reasonably short term. The response of the market place is less certain, however. Australia Post will be using the new breed of fax to beef up a service called Imagegram, which is aimed at domestic consumers rather than the business community.

Introduced by Australia Post in June 1985, Imagegram is a domestic electronic message transfer service. Text and graphics can be transmitted around Australia for courier delivery within four hours. As an optional extra the message or drawing can be delivered inside an Imagegram greeting card.

Peak use of Imagegram, a service described as "a telegram with imagination" is on Valentine's Day, Mother's Day, Father's Day and at Christmas. There is also a steady business year round for birthdays, engagements, weddings and anniversaries.

"Because we wanted to establish a solid network of Electronic Post Centres before launching promotional activities for Imagegram, consumer awareness is not at its peak," said Mr Quinn. With over 500 EPCs and more coming on line awareness campaigns now under plan are expected to generate considerable additional Imagegram business for Australia Post.

Also little promoted, but potentially an excellent money spinner, is E-Post, the last in the trio of Australia Post's electronic mail services. Commencing operations in October 1985, the computer-based E-Post service is a multi-dimensional setup with applications for consumer and business alike.

While "How to Write to 1000 People at One Time" is a catchy advertising headline it's a reality with E-Post Lettergrams. The bones of this message transfer service consist of the Electronic Mail Acceptance Centres, the EPC network and high speed printers. After lodgement by a telex, phone (to a special E-Post operator) or in person (to any EPC) the E-Post system provides for the typing of customer letters and messages, their electronic transmission, laser reprinting on business quality stationery, enveloping and delivery in as little as two hours using a courier or by next day postal service.

"Such a service has enormous benefits

for businesses which need to cost-effectively reach consumers," said Mr Quinn. A high volume user like American Express, for instance, can prepare a letter, have its computer-stored address list activited and send out up to two A4 pages to 1000 individual addresses.

The travel industry and airlines in particular, frequently use the Lettergram 'Bulletin' service for agent notification of last minute changes to flight schedules. Debt collection agencies use it to issue reminder notices while clubs use it for sending newsletters to members. Many companies have found E-Post to be the best way to send urgent information to sales representatives and retailers who do not have telex facilities.

This text-oriented, computer-based service was expanded to the USA in mid 1986.

For the most part, E-Post is designed as a service for the business community. However, it is expected that the general public will find some of its options quite attractive. For instance, it is the most directly comparable to telegrams among the new services. Sometime in mid 1989 the familiar green border telegrams from Telecom will cease to exist. In their place will be blue Australia Post Lettergrams. The advantages being mass marketed to consumers through a series of ads that began in January are that Lettergrams are easier to read, they are as fast as telegrams and they offer more words for less money. Consumers will have the option of 30 word and 10 line (approximately 100 words) Lettergrams or 2 page letters at savings of up to 80 per cent over existing telegram rates. As an added bonus a free confirmation copy of what's been sent is provided to the client.

While the general public won't have the flexibility of telex or fax lodging Lettergram, Mr Quinn believes that by mid 1988 the mechanics will be in place for personal computer access into the E-Post system. Using Viatel it will be possible to send a hard copy message to anywhere in the country.

Individual PC access to E-Post services is likely to be followed by access to individual PCs by E-Post business customers. For example, instead of sending a hard copy Lettergram to x number of customers a business house might opt to send a message direct to x number of PCs. And while the postman may never be electronically replaced it's most likely that in the Australian home of the 1990s it will be equally important to read the day's electronic mail as to open the morning's post. ●

Australia Post, Intelpost employee, Grant King, sends the judgement on the Peter Wright MI5 case to London.

SURFACE MOUNT TECHNOLOGY PART 2

Surface mounting requires new machines and new techniques, but offers new promises as well.

Les Cardilini

Surface mount technology (SMT) offers a significant reduction in the size of electronic equipment by increasing the density of components on printed circuit boards and other substrates. At a recent meeting, a group of engineers offered this as the main reason they had installed equipment to handle and assemble surface mount components (SMCs) in electronics production.

However, before entering into SMT, it is necessary to rethink the way assembly is done. Compared with leaded components, assembly of SMT processes tends to be more automated even where smaller production runs are involved. Accordingly, SMT is inherently less labour intensive, but this is not the only reason for going to SMT. The majority of surface mount components are, in the main, too small to be handled using traditional manual pick-and -place methods.

Not that manual handling is impossible. Manually operated SMD assembly machines, and re-work stations of various complexity, are available for smaller batch jobs in both production and R&D projects. But by and large, SMT requires big, fast machines capable of hundreds of placements a minute.

The larger, software Robotic SMD assembly machines, move just a little too fast for the casual observer to see what is actually happening when the machine selects and then places a single SMD precisely in position on a circuit board. The slower action of a simple hand operated, SMD pick-and -place system, affords a better appreciation of the dexterity and accuracy required and of the program routines needed to control intelligent assembly equipment.

The basic requirements are to provide some means of keeping the small SMDs readily accessible to the assembler and a way of picking them up, one by one, and placing them with some precision on the board. The SMDs must then be retained firmly in position on the solder pads of the board until the board is soldered, otherwise the components will move about during subsequent handling processes. An adhesive is needed to keep them in place.

The discrete steps of SMD assembly are easily disguised in the seemingly single actions performed by human assemblers and have to be programmed individually into robotic assemblers. These include, among other things, selecting the next component and confirming that it has indeed been picked up, finding its X-Y coordinate on the board, centreing the SMD and placing it down precisely on its solder pads on the board and releasing it, and finally confirming its release, before returning to pick and place the next part. Similar considerations need to be given to the placement and quantities of adhesive and solder paste.

Cooper Tools, in Albury, New South Wales, markets the Weller Pick-Place-Solder (PPS) system, a versatile, self contained manual work station for the application of glue or solder paste spots and the positioning of SMDs by means of temperature controlled inert gas. The Weller PPS components are dispensed from tapes racked towards the rear of the work table, or from a rotating turntable magazine.

Similar equipment having various degrees of sophistication is available from other distributors in Australia and each has its special features. For example, the Kepro system distributed by the Hawker Richardson organisation provides a moving platform on which the operator can rest his or her wrists during the assembly process. The platform support slides in both the X and Y directions between the component dispensers and the circuit board, which is clipped firmly in place on a rotatable, turntable pad.

The main advantage of the mobile wrist support is that it greatly reduces the chances of the operator suffering repetitive strain injury from excessive arm movement during long assembly sessions, according to a spokesperson for Hawker Richardson. Supporting the wrists firmly also helps in steadying the components and tools during delicate placement operations on densely populated printed circuit boards.

Bench instruments such as the Model SMD 602 from Scope laboratories, which dispenses precise dots of fluids, from watery solvents to thick pastes, and has vacuum pen attachments for picking and placing SMCs, are also available for use in smaller assembly and job environments.

Big machines

At the other end of the scale are the larger, faster and more expensive models, the building blocks which may link together to extend production lines as requirements grow. Accessory modules such as line buffer zones, adhesive dispensers, soldering plant and board handling equipment can be integrated into customised, software controlled systems.

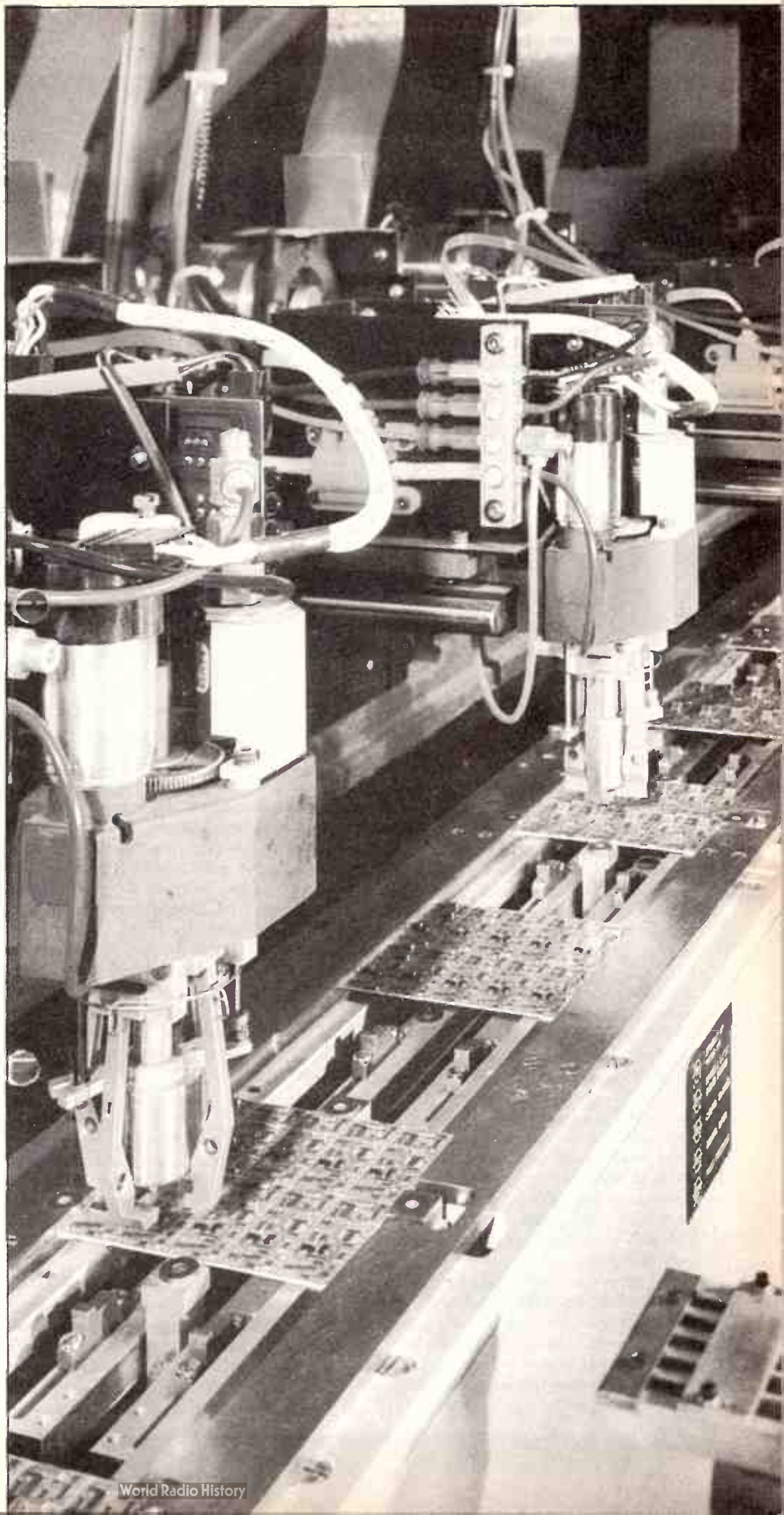
In between, the automated, table-top SMC mounters are probably where many contenders enter the SMD stakes and gain their first real experiences in SMT production and programming. Typical machines of this type operate under software control and can accommodate a variety of automatic component-dispensing magazines. Printed circuit boards are mounted in place according to index marks from which control routings are referenced.

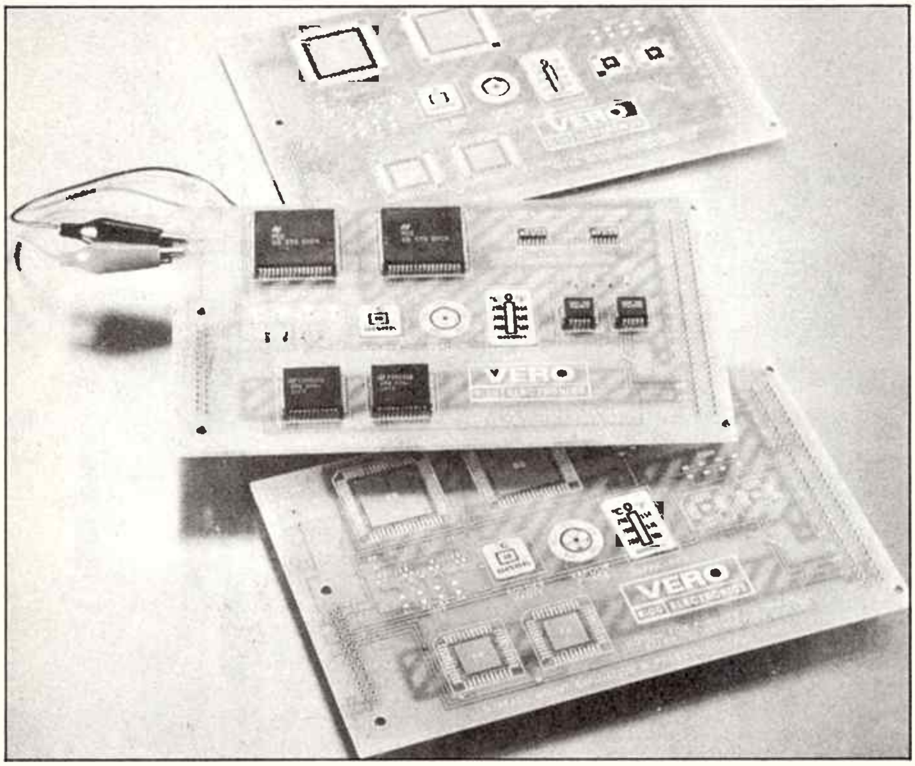
The head of the insertion machine centres the SMD prior to placing it on the substrate and may be programmed to retry on "soft" mishaps, or alert the supervisor if the process fails at any point in its sequence, rather than soldering on, making faulty assemblies.

Soldering

Most readers will be generally familiar with wave soldering techniques. Many SMDs readily lend themselves to wave soldering and, in fact, wave soldering is necessary when working with leaded components and SMCs on the same printed circuit board.

Other soldering options in SMT include Vapour Phase and a variety of Re-flow methods such as focussed and far infra-red heating. Of major consideration is the heat distributed over, and retained by, the substrate and components during the soldering process, and the heat conducted inside the





chips and other components.

The Vapour Phase process involves boiling a liquid such as freon to create a zone of hot vapour which condenses on exposed metal pins and connections. The condensing vapour gives up heat, causing the part and, more particularly, the solder paste to rise in temperature, thus activating the flux and evaporating the binders and by-products in the compound. The board is then drawn through a cooler zone which reduces the temperature of the job, solidifies the solder and also recondenses rising hot vapour back into the main reservoir of the expensive fluid. In this process temperature can be controlled to around the boiling point of the fluid.

Infra-red re-flow systems heat through direct, focussed radiation, or by conducted or convected heat applied above and below the board as it passes through the various zones in the solder process. Some components may tend to absorb more radiated heat than others because of their colour, but this may be controlled by selecting an appropriate wavelength for the infra-red source, to obtain a more even heat distribution.

Hot inert gas is also used for soldering and de-soldering SMDs. It can be applied under pressure, through nozzles and jets for fine working or via surrounding ducts in larger heads shaped to, say, pinout profiles for flatpacks. Replaceable heads of this kind are availble with table top SMD work stations and other soldering systems.

Solder application

Placing the solder paste onto the circuit board pads can be done by hand using a suitable dispenser. On bigger substrates and where larger production quantities are involved, however, manual application of solder paste may prove tedious and less reliable than automated or semi-automated methods, using printing techniques. Screen printing, in particular is widely used in SMT and is able to provide the necessary resolution and accuracy required on the board. This means more tracks on less area of board and closer pin spacing of ICs. Also the heat distribution around the board will affect the uniformity of the solder re-flow.

Stencils are used for placing solder paste on boards, as opposed to the open mesh of the screen in the case of screen printing. Both processes are similar insofar as solder paste is puddled on top and forced through the pattern and on to the substrate, held accurately in place underneath. A squeegee action pulls the solder paste over the screen or stencil. The thickness of the stencil or mesh controls the thickness and uniformity of the solder paste. Needless to say, the accuracy and uniformity with which the solder paste is applied to the board is a crucial part of the operation. So, too, is the accuracy of the printed circuit board layout and reference marks used to align the boards in the printing machine.

Boards

Printed circuit boards and substrates require a great deal of attention to detail, especially where large production quantities are involved. The density of components on surface mount boards and the finer track work both make reworking and subsequent inspection more difficult. Accordingly, the fewer boards that need to be reworked the better.

Mr Ray Smith, of RCS Design in Alphington, Victoria, pointed out that the cost of good board design for SM assemblies needed to be considered in terms of the cost per board, rather than in terms of the cost of the design process alone. Where many thousands of boards might be produced from one design project, the cost per board is minimal, so its worth spending money to get it right. According to Smith, some manufacturers do not see it that way and miss out on the benefits of early investment on long term production and in-service reliability.

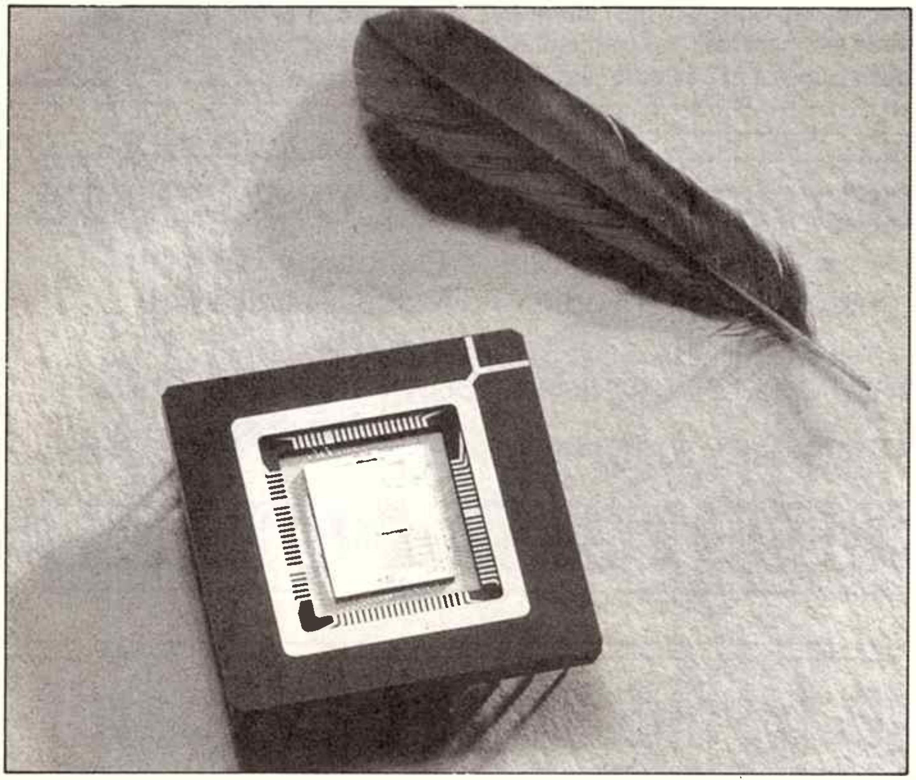
Printed circuit boards for SMDs must be laid out to suit the soldering process being used. With pins and devices placed so close together, heat distribution around the board, and the changes in surface tension as solder flows over adjacent pins in different patterns, can result in the bridging of pins and tracks. Bridging can also occur when SMCs pass through solder waves, side-on to pinout arrays. Re-flow soldering, on the other hand, does not pose a similar problem.

Another critical feature of board design, especially where such small components are crowded into a confined area, is the accuracy of indexing or reference marks. These are used to line the boards up in the various processing stages such as, screen printing and setting up in insertion machines. Relatively small discrepencies in squareness or setting up could find some components misaligned on their pads.

There is currently vigorous interest in surface mount technology. Component suppliers are active and a number of distributors have production and re-working equipment available. Most seem very keen to talk to potential users of SMT and some see the industry on a very exciting learning curve in its application.

At Hawker Richardson in Melbourne for instance, a variety of equipment they sell has been set up for demonstration and to help intending users of SMT assess its viability for their particular purposes, even to the point of 'running a few boards through to try it out', from small manually operated work stations to solder application and automated "monsters". ●

TRANSPUTERS



The Inmos T 800 from Inmos. On its own it performs better than such state of the art devices as the 80386, but connected to other transputers it is capable of the most amazing tricks.

While the general media still bestows its ultimate accolade "computerised" to signify the latest in awe-inspiring and indisputable record keeping, computers are old hat. Now, in fact, it's transputers, taking the computer further down the road of parallel processing.

Jon Fairall

Are there any limits to the growth of computers? Year after year, they grow more powerful, smaller and cheaper. A straightforward extrapolation of the record of the past 20 years would seem to indicate that by the turn of the century the world's fastest computer, the mighty Cray, will fit into the case of your IBM PC, and cost about as much. And the Cray itself will be running several hundred times faster.

But if this does happen, it will not be via the operation of the same factors that have driven the progress of the last 20 years. Since the days of the early pioneers, the performance of computers has depended on the performance of the microprocessors that underpin them. As the chips have got denser, cheaper and more powerful, so have the computers.

Now we face some fundamental limits imposed by nature. Currently, designers are battling with the beginnings of sub-micron technology. The price for marginal advancement now is an exponential increase in the cost of manufacturing. Additionally, we are actually coming to the stage where we can measure our creations in the number of molecules they contain. We can't make them any smaller, thus we can't make them any faster.

Indeed, the only way to obtain orders of magnitude improvements in speed would be via optical computers.

The Von Neumann Bottleneck

If we can't make computers better by making the devices that drive them better, perhaps it's time to look at the way we make computers. After 20 years of miraculous development, we still make computers according to the method of Von Neumann, the guru of early computer science, who suggested the fundamental architecture of input/output, memory and CPU that we still see today.

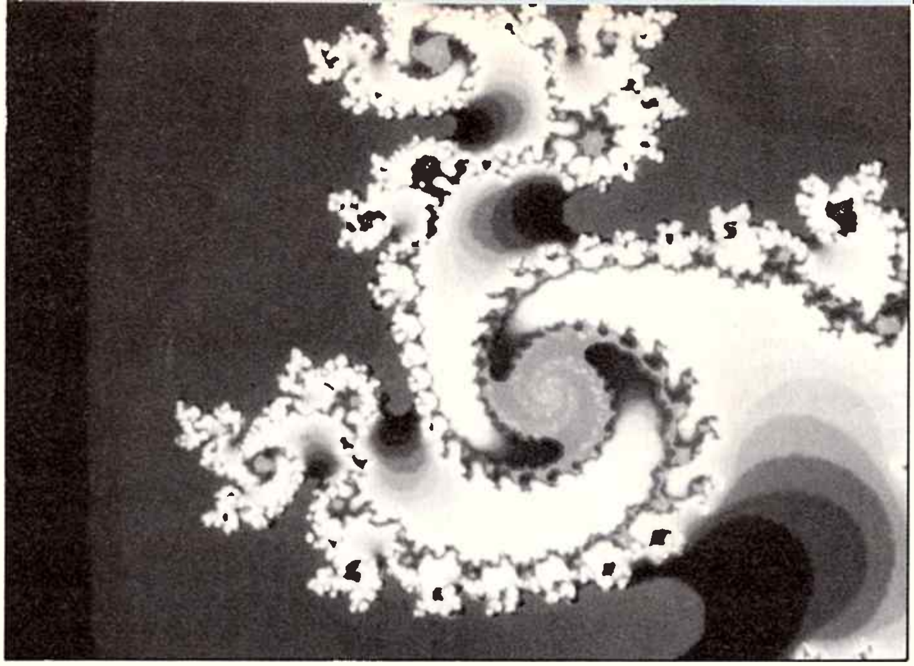
The problem with such a method is that it makes the speed of the whole dependent on the speed of the slowest of the parts. To do the most trivial operation, information has got to pass out of the CPU into the memory, and probably down the line to the I/O section. This is the Von Neumann bottleneck.

Since the early 1960s, computer scientists have looked for a way around it. Early on they latched onto the idea of parallelism; the idea that information should be solved by dividing them up into small bits, processing each bit independently, and then recombining them into some sort of whole.

It's easy to state this proposition, more difficult to achieve it. Some of the conceptual problems include: how do you divide the information up, and problems of synchronisation.

Over the last few years, various architectures have evolved that have been parallelled to a certain extent. For instance, a trend in PC design has been to divide some of its functions into more manageable chunks. One processor might look after the screen, another after the keyboard, another might do arithmetic calculations and so on. Since in the early generation of PCs a considerable amount of processor overhead was devoted to these housekeeping functions, and the strategy has had some considerable success. Nevertheless, the process is still I/O-bound.

Another relatively new development has been the advent of chips with a certain amount of parallelism built into them. The architecture of the computer remains the same, but the chips operate substantially



A Mandelbrot plot converts obtuse mathematical arguments into visual splendor. Transputers can generate such images in a fraction of the time of sequential processors because so much of the calculation can be done concurrently.

faster because of their architecture. This is the case with all the latest generation 32-bit processors, like TI's 32020.

Parallelism

However, the first truly parallel processor, designed from the ground up for parallel processing, is the transistor computer, or transputer, from the British semiconductor company, Inmos. The first of these revolutionary devices, the T414, arrived in Australia a year ago, and has subsequently been augmented by the T800. A third variant is expected shortly.

How is a transputer different from an ordinary CPU, and how does it support parallelism?

For a start, all the members of the transputer family consist of an entire Von Neumann computer on a single chip. it has a conventional CPU unit, its own RAM, 2K on the T414 and 4K in the case of the T800, and four high speed serial communications ports to handle I/O. The new chip expected at the year's end will have 64K on board.

Four kilobytes of memory may not seem breathtakingly large, but there are two points to remember. One is that it's quite possible to download a program to the chip through one of the links without providing any external memory at all, they are that fast. The second and probably more significant point is that a transputer is designed for parallel processing, so its part of any largish program will probably not expand beyond 4K. But even if it did, the T800 will support 4G of external memory directly from the pins of its address bus.

A useful analogy for a transputer is to think of it as a PC on a LAN, its I/O functions much like an RS232 port or even more accurately, like, say, the LAN Ethernet. As in any LAN, a large number of CPUs can be connected together to form a distributed computing facility. Likewise, transputers can be connected together, to form a single large computer. It is possible to connect each of the four I/O ports on the individual chips to another transputer, thus providing great flexibility in designing the network topology.

In fact, this analogy with a LAN can be pushed considerably further. It is possible to have a transputer network spread around the world; a bit in Sydney, a bit in Melbourne, perhaps even in Timbuktoo.

This parallelism in the network architecture is mirrored by the topology of the transputer itself. A transputer can communicate via all four of its I/O ports while at the same time carrying out operations in the CPU and talking to the floating point unit on board. There is some degradation in performance when the chip is pushed in this way, but very little compared with, say, the 80286, which is so seriously I/O-bound that according to tests run by the American *Byte* magazine, the 80286 in combination with the 80287 floating point chip is actually slower on some operations than the 80286 alone.

Occam

The performance specifications of the T800 chip are blinding. However, no matter how good the chip, it's pretty useless without software. The transputers have the advantage that they were designed in parallel with a language called Occam, and the two have been tailored to jointly maximise each other's advantages.

It is a true parallel language, in as much as it was designed from the start to have parts of its program running concurrently. The hardware links that obsess the circuit architect now become channels over which the programmer may pass the results of a particular sequence. Actually, strictly speaking, a channel may simply link one memory location to another memory location in a single transputer. It is not necessary for the programmer to know precisely where the program is running, although the way processes are allocated to processors makes a difference to the performance of the program.

As a practical example, say we wish to find a value for e. Mathematically, this can be solved by applying a Taylor series. If student days are long gone, recall that a Taylor series is a series which, as you add more and more terms, converges ever more accurately on some specific value.

The conventional method of solving this in a computer is to pick a sufficiently large value for i in a FOR . . . NEXT loop. Each time the computer solves the expression, it adds the result to the previous total, until at some arbitrary time the answer is sufficiently accurate. The accuracy of the answer is determined entirely by the length of time you wish to spend obtaining it.

The Occam approach would be to develop a process to calculate a single term in the series, and then run each of these in parallel. When the calculation is finished the results are summed in another process.

Notice that now the performance of the program depends on the degree of parallelism, ie, the number of transputers, and that can be made arbitrarily large. (Of course, this is a ridiculous example, since at $800 a pop, the excitement of computing e to large degrees of accuracy could easily pall. Nevertheless, there are plenty of applications where the problem is not trivial.)

Applications

The main applications for transputers will be the massive number crunching operations that now occupy Crays and other machines. Weather forecasting, voice recognition and video graphics are just a few of the applications that will be ideally suited to this sort of thing. We know, more or less, how to do them, but our best efforts at the moment are being thwarted by a lack of computer power. transputers will provide it.

Parallel processing computers are now under development at many universities and computer companies around the world. Already, transputer-based products that exceed the performance of the Cray 1 have been developed. The British Meiko company, for instance, has developed a calculating engine called the Computing Surface and in the US, Floating Point Systems have put together several thousand transputers.

One of the first transputer-based products in Australia will be a 20-transputer video system from Integrated Arts in Sydney, which listed on the second board of the Sydney stock exchange in October. The company is running a million dollar R&D effort to get the product out soon.

At the bottom end of the market, plug-in boards for the IBM PC are already available that have an array of transputers on them. Indeed, Inmos itself has developed a demonstration card like this called the IMS-B003-1. Atari is developing a transputer-based micro that will be well and truly the fastest PC in the world — for a short period of time.

The potential of this area beggars belief. Within 10 years the advent of the personal supercomputer is a distinct possibility. Inmos predicts a 10-fold speed increase in the T800 by 1989, and is already researching a transputer with 32 I/O ports. There are really only two obstacles to be solved, one is the cost, which at the moment is frightening, and the other is software development. Cost will, inevitably, come down for all the usual reasons. According to a spokesman at Hawk Electronics, the A$ price of a T800 has already slipped $100 since the beginning of the year. Software is already under development. The future is here now. ●

Programming in Occam

The first thing to notice about programming in Occam is that it can't be taken for granted that the processor is executing instructions conventionally, ie, in sequence or in parallel. Thus, each module (or 'process' in Occam jargon) of the program is headed up SEQ or PAR depending on its status. Once you understand the distinction, the actual structure of Occam is really rather simple. Occam is well named.

The reference will be obscure to all but students of Philosophy. William of Occam was a major 12 century English philosopher who is known mainly for his dictum that one should not make things unnecessarily complex. It was the first enunciation of the KISS (Keep It Simple Stupid) principle.

To illustrate how Occam works, consider the following example (from *A Tutorial Introduction to Occam* programming by Dick Pountain and David May, BSP Books, 1987). Imagine the task is to knit a jersey. A sequential method of tackling this might be:

```
SEQ
  ... knit body
  ... knit left sleeve
  ... knit right sleeve
  ... knit neck
  ... join bits together
```

where SEQ means "do in sequence" and is pronounced "seek".

This works fine provided there is just one knitter. If there were several, it's grossly inefficient, since now one knitter, doing the neck, must wait for another, doing the right sleeve, to finish before the task can begin.

A more efficient way would be for everyone to knit their piece of the sweater together, and then to join the various bits. In Occam type notation, we might write:

```
SEQ
  PAR
    ... knit body
    ... knit left sleeve
    ... knit right sleeve
    ... knit neck
  ... join bits together
```

which instructs us to sew the bits together concurrently, and then to sew it all together afterwards (sequentially). Notice that the string of dots must be indented two spaces, and there must be two spaces after the dots.

The analogy with a computer programme will be perfectly clear. Of itself this is simple enough, however, there are many traps for the unwary. The most elementary, and the most difficult to solve, have to do with timing. Notice that since all the parallel processes are independent of one another, each will start, run and finish irrespective of what happens to the other. This poses problems if an output from one process is needed as the input of another.

To push the analogy a little further, assume that before the sleeves and neck can be knitted, the body process must finish, and measurements sent to the other three processes. The body process will run perfectly. As things stand, however, the measurements will reach the other processes just as they are themselves finishing. These other processes will have run without any measurement and the measurements generated in the body process will disappear into thin air. The result: garbage.

Occam takes care of such timing problems in its fundamental structure with channels. Channels communicate from one process to another. A hard channel communicates at 20 MHz between processors. A soft channel runs at 80 MHz beteen two memory locations on the same processor. However, this is a hardware distinction only, since Occam can't tell the difference between the two types.

A channel only becomes available when a sender is ready to send and a receiver to receive. Thus in our example the sleeve process would halt and wait until the body process was ready to send. It is not necessary for the programmer to worry about synchronisation since this is implicit in the structure of the language.

Clearly, channels are vital to concurrent programming, and as one would imagine, easily defined within Occam. Indeed, in Occam, using channels to communicate a value from one process to another is no more difficult than using a variable to store a value. Occam uses the convention ! to mean output, and ? to mean input from a channel, so that A!2 means output the value 2 in channel A and A?B means take the input from A and place it in variable B. So:

```
A!2
A?B
```

is idential to B=2 in a normal concurrent program, except that the value 2 exists on one processor, and the variable B on another.

Although Occam is very forgiving to programmers there are still traps for the unwary. The most interesting is called deadlock, and occurs when a process is hung waiting for an input that will never arrive. For instance:

```
PAR
  SEQ
    comm2 ? x
    comm1 ! 2
  SEQ
    comm1 ? y
    comm2 ! 3
```

Here we have two processes operating in parallel. The first one tells us to look at the channel comm2 and place the value there in the variable x, then place the value 2 on comm1. At the same time, we are to place the value on comm1 into y, and output 3 to comm2. The problem is that the first process will never get past first base. Why? Because there will never be a value on comm2, as the second process, which should provide the value for comm2 is also waiting patiently for a value from comm1 for y.

The example is obviously trivial, but a little imagination will show you that deadlock would be easy to achieve if one was swapping values back and forth between a number of processes. Unfortunately, it's not possible to avoid deadlock by minimising the use of channels. They provide synchronisation between different processes and if they are not used, the result may well be that one process will finish long before another, so that the program makes very innefficient use of the number of parallel processors.

However, in Occam, it is possible to prove that a program is deadlock-free, and use the same techniques to build deadlock-free systems (the terms are "deadlock-free by construction", and "deadlock-free by inspection").

In fact, Tony Hoare, of Cambridge University, who originally proposed the theory of CSP (Communicating Sequential Processes) and went on to specify Occam, with Inmos, has written the "*Laws of Occam Programming*", and with other documentation around, it is now possible to feasibly prove programs follow a particular specification.

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Sight and Sound News

Cover

Trevor Lees Ribbons

The new Trevor Lees Ribbon speaker is a completely Australian designed and built system.

Superb dynamics and clarity are just two of the strengths of the speaker system the maker claims, which the system uses some of the most up to date technology to provide a ribbon driver capable of operating from the lower midrange frequencies up to the limits of audibility. Complementing the midrange/tweeter is a specially designed and constructed subwoofer system using low mass yet high rigidity materials.

The ribbon driver itself stands approximately 1.83 m tall, which, therefore avoids one of the major drawbacks of most planar speakers: that of poor vertical dispersion. The Trevor Lees ribbon provides a seamless output along its length, consequently there is no high frequency rolloff if the listener is standing.

The principle behind a ribbon driver consists of a thin metal conductor — usually pleated aluminium which itself forms the diaphragm. Powerful permanent magnets placed either side of the ribbon provide the magnetic field. Generally the ribbon and, therefore, magnet spacing must be narrow to provide sensitivity, however, horn loading and/or matching transformers are usually required.

The Trevor Lees ribbons have been designed and constructed to provide a sensitivity of approximately 88 dBw/metre (far higher than competing designs) and a dc resistance which can be tolerated by most high quality transistors and valve amps — without the need for an impedence matching transformer.

The benefits of this design are immediately audible and its sensitivity allows the use of small yet high quality valve amps (as small as 35 watts per channel).

The complementary subwoofer system has been designed from the ground up to match the unique qualities of the ribbon driver. Compound loading, whereby a second unseen driver works in tandem with the visible driver within the cabinet, was found to give the cleanest and most extended bass. Mounted in an amnidirectional configuration it is an excellent match to the dipole characteristics of the ribbon assembly. Special attention has been given to the crossover which has been kept as simple as possible; it uses top quality components and hand wiring.

READER INFO No. 20

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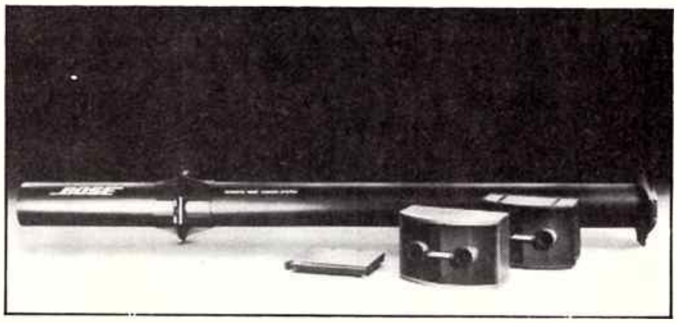


Big Bose

The Bicentennial Festival of Sydney saw the largest Bose speaker rig in the world performing in the Domain. The system was put together by Sydney's PA People and consisted of 219 Bose 802s and a massive 55,000 watts of amplifier power.

Not to be outdone by the Aussies, the Bose parent company in America has put together a massive rig consisting over 400 Bose 802s and 75,000 watts of amplifier power, for the Winter Olympics in Calgary.

And another new Bose product is on the horizon. Based on the same technology as the award winning Bose Acoustimass hi-fi speaker system, Bose has just released a professional bass system called the Acoustic Wave Cannon.

The Cannon is a 3.8 metre (12 foot) long, black tube containing one 12" loudspeaker placed about three quarters the way along the length of the tube. It's aimed basically at the cinema and installed sound system market and was recently seen being used at the Sydney Bicentennial BHP Steel Outdoor Movie Season at the Sydney Opera House. A domestic hi-fi version of the Cannon may well be seen on the market on Oz towards the beginning of 1989.

READER INFO No. 21

Equipping the Composer

A mixing and monitoring tool called the HM42 designed to assist musicians and composers in writing, arranging and recording with multiple instruments has been released by Rane, challenging the conventional eight track mixer.

The HM42 allows four stereo line level inputs to be independently mixed down to a stereo program which can be monitored via two powerful headphone amplifiers with separate level controls.

Several MIDI keyboards and drum machines can be linked together to the desired mix, which can be recorded via separate outputs on the rear panel. An EXPAND IN and OUT feature allows two or more units to be linked together for more inputs and ouputs. Alternatively, the model HC6 headphone console can be used to permit eight headphone outputs to independently monitor the mixed program.

READER INFO No. 22

Sony Cameras

Sony has released two new video 8 products.

The CCD-V50 Digital Handycam is a second generation unit to the popular CCD-V30 and includes the same built-in playback deck with the added features of a 'digital superimpose' function, a 6X power zoom lens with macro function and a date/time display system.

With the superimpose function and digital memory IC the CCD-V50 can memorize points of high contrast, from handwritten titles to three dimensional objects, for use at any time. Users can choose from a palette of eight video colours, white, blue, green cyan, red, violet, yellow or black and superimpose over a scene being recorded at any time desired. So titles (or graffiti) can be quickly and easily in any language.

The unit's 6X power zoom lens has either manual or motorized operation which permits steady, smooth zooming controlled by finger pressure only.

Other features include autofocus to maintain clear sharp pictures, and auto-linear white balance to ensure colour balance even when moving the camera from indoors to outdoors.

Playback is easy, through the electronic viewfinder, or directly connected to a television or monitor. The CCD-V50 also has full electronic compatibility with all ½-inch formats for easy dubbing and editing. There's also a special edit switch to minimise loss of quality while dubbing.

The unit is equipped with AFM hi-fi sound, a backlight function for a better picture even with strong light behind the subject, a Rec-Review function for instant playback, a fast access function for easy image search and a standby mechanism that prevents accidental shooting.

The CCD-V50 has a Charge Coupled Device (CCD) image sensor incorporating 291,000 pixels for superb picture detail, sharp colours and superior low light performance, without image lag or burn-in. RRP is $3125.

Marking Sony's involvement as the official supplier of video cameras to the Australian Bicentenary celebrations is the less expensive Limited Edition CCD-AU200 Video 8.

The special features of this camcorder include a 2.5X zoom lens, infrared autofocus as well as manual focus, a backlight control, linear auto white balance and auto iris and adjustable electronic viewfinder.

The camera playback by connecting to a TV or monitor. For checking scenes on location (so to speak) the viewfinder works in conjunction with the REC-REVIEW button. RRP is $1988.

READER INFO No. 23

New JVC VCR

Not the cheapest VCR on the market, the new JVC model HR-D210EA is nevertheless worth a look. Its features include a VHS Index Search System by which the recorder searches and automatically restarts playback at the beginning of a recording; an on-screen pause display which shows a white bar on the screen during recording; and a Next Memory Function which sets the machine into the selected mode immediately following fast forward or replay.

Other functions are a 14-day, four-event timer; remote control; automatic playback, power on/off, eject, rewind, backspace, editing and pause release; shuttle search with locking function; noiseless still; instant timer recording; and electronic tracking controls with auto reset. RRP is $799.

READER INFO No. 24

Matsushita Overcomes CD Noise Problems

Two new Matsushita (Technics) CD players released in Japan come equipped with circuitry to overcome the problems of zero-cross distortion and computational error.

The problems are evident in the quiet passages on CDs. When a CD signal is small the D/A's output becomes zero because the accuracy of the converter is lost due to all the accumulative errors in the converter. The result of these low levels signals is a muddy or distorted sound. In the oversampling process the digital filter and adder are used to remove the unwanted noise which produces computational error. According to Matsushita, at least one extra bit making a mimimum total of 17 bits is required to be output, if this error is to be minimised. The omission of this bit and all data beyond constitutes computational error and causes distortion when the signal is small.

Matsushita solves these problems in its SL-P990 and SL-P770 models by using a four-D/A converter system (two converters for each channel), and an 18-bit system for computational error. The four D/A systems detects whether input data has a positive or negative MSB (most significant bit). If it's positive with a value of 0, input data is output to DAC(a) of a single channel. During this time, zero is output to DAC(b). Alternatively, when the input data is negative, (MSB equal to 1), it is inverted and processed to DAC(b) and zero is output to DAC(a). By seeking the differential ouput of both D/A converters an output free of zero-cross distortion is possible.

The other new technique of an 18-bit oversampling filter produces at least 17 bits when input of 16 bits passes through the digital filter. When the signal is small the 18-bit system shifts its level and processes 17- and 18-bit levels. In this way it raises the amount of information and minimises computational error.

In addition, by taking the differential of the (a) and (b) converters, noises of the same phase are also cancelled. The four-converter system also passes through the differential output via an adaptor to reduce noise.

READER INFO No. 25

AATEC Goes International

Australia's only video tape manufacturer, Perth-based AATEC Australia, has won an international endorsement for its product.

AATEC has been awarded the licence to use the prestigious VHS logo by Japanese electronics giant, JVC. The award follows stringent testing of AATEC tapes in Australia and Japan by JVC engineers.

The licence cements a multi-million dollar deal to supply video tapes to West German electronics company BASF, one of the world's biggest manufacturers and distributors of magnetic tape.

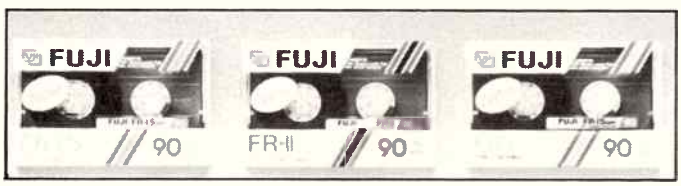
Under the arrangement AATEC will produce BASF tapes for the Australian market from its Perth factory. BASF, which has a significant share of the Australian retail market, has taken over the retail marketing of AATEC tapes in Australia.

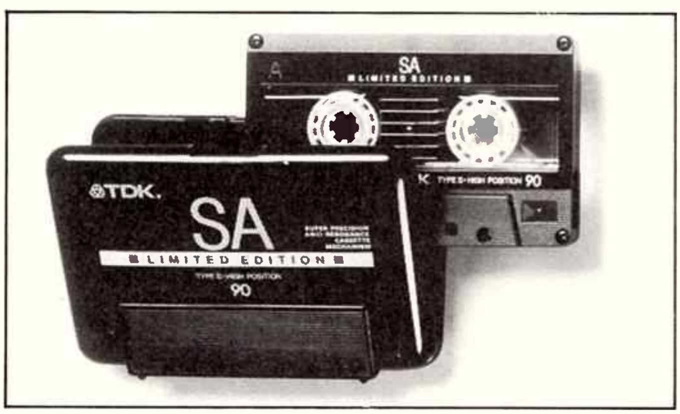
The VHS licence and deal with BASF puts AATEC in a powerful position to tackle world markets.

Other major recent AATEC achievements include winning an Australian Design Award for technical excellence; toting up sales to the United States worth in excess of $1 million with further sales to come, and commencing exports to Malaysia and New Zealand.

READER INFO No. 26

Fashionable Cassettes



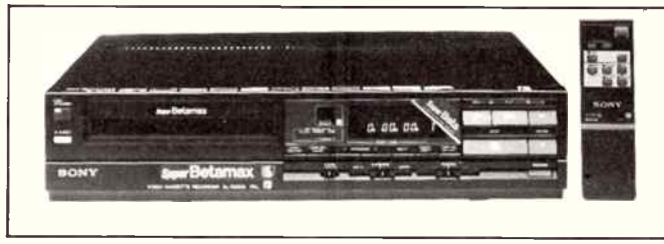


TDK and Fuji have taken a new tack on marketing their cassettes. Both have introduced a new look, TDK providing a new rounded package for the cassette, the "take anywhere" look, while Fuji has favoured a transparent shell covering the tape spools.

The new tapes for the (extremely) fashion-conscious are the TDK SA-LTD, the familiar SA tape in a "Limited Edition" format, and the wider Fuji range.

Fuji has also released a cassette specifically for use in the car. The new GT-11 has what Fuji describes as Zero Meltdown capability, which means that it should be able to withstand in-car temperatures as high as 230 degrees F. The other claim Fuji makes for it is that the GT-11 is "vibration proof".

READER INFO No. 28



Sony Denies Abandoning Beta

The first Sony VHS home deck VCRs are expected to go on sale in Europe this month and to be available in Australia towards the end of this year or the beginning of next year, according to a Sony spokesman.

The sales of VHS equipment follows Sony's recent announcement that it is adding the VHS format machines to its Betamax and Video-8 lineup in recognition of the high proportion of VHS to Beta machines in many countries. In Australia, according to Sony, that ratio is about 80 to 20 and the decision comes as an attempt to lock into that market and to facilitate compatibility between its other products and the desire for a VHS machine by customers.

Initially Sony will be supplied VHS machines by Hitachi on an OEM basis at the rate of 5000 per month. Production will eventually be brought in house.

However, the company is keen to impress that it has not abandoned its traditional formats. Production of Beta machines in 1987 was about 1.4 million units which Sony claims makes Beta still profitable. There is still, according to Sony, a strong demand for Beta by the high-end market for its superior quality, and while JCV's marketing made VHS popular in much of the world, in places such as the Philippines, South America and the Middle East, Sony claims a greater saturation of Beta equipment. Underlining its support for Betamax, Sony recently released another home deck, the SL-S2000.

Sony's adventure into alternative formats stops at the home VHS. It has announced it has no intention of introducing VHS-C, the VHS camcorder format with small cassette which is compatible with a home VCR deck, and is happy with the success of the Video-8 format. Overseas, NTSC countries are being seduced with S-VHS, a new 'super' VHS format, however, Sony is concentrating its marketing on its new SuperBeta and ED-Beta formats although it may eventually market S-VHS devices also.

READER INFO No. 27

Speaker For High Quality System

Loudspeakers are coming in ever more varied shapes and sizes and the new Martin RS802 doesn't disappoint. The unit is housed in a compact trapezoidal cabinet and is fitted with standard flying points to allow suspension upright or inverted. Pairs of M8 bushes, are fitted top and bottom for wall bracket or stand mounting.

The speaker is a 'mid-high pack', two-way, horn-loaded system. It uses high-efficiency drive units coupled to horizontal constant directivity (HCD) horns designed by London-based Martin Audio. The result is a claimed high output, low distortion and well defined dispersion over the 200 Hz to 20 kHz band.

READER INFO No. 29

IN BRIEF

More than you bargained for

According to a report in a recent *Australian*, police in New York are searching for the demon video intruder. Apparently a person or persons unknown is hiring video movies and contributing gratuitous sex scenes to the end of the movies. "Right after the credits at the end you see a man and woman involved in various sexual acts for about 10 minutes in full colour," explained one shop owner.

Tampering with hired videos is not unusual, although a local video shop employee had never heard of this type of intrusion. He did, however, estimate that between 30 per cent and 40 per cent of the movies hired out are taped illegally onto other cassettes. Rather than try to prosecute these people, video stores are providing for them by selling cassettes and labels as well as ex-rental copies.

A Bob Each Way

A recent report we came across described a kit from the US company Adaway Systems which apparently attaches to the VCR and blocks out any commercials interspersed in a program being recorded. In an expansive gesture, Adaway also offers a device to broadcasters that defeats such units.

Another DAT Bill

While the world awaits the outcome of the US National Bureau of Standards tests on the copycode scanner proposed by CBS for installation on Digital Audio Tape players, another bill has been introduced into the US Congress to prohibit the importation of DAT players. The copycode scanner has been proposed by CBS Records to prevent DATs infringing copyright and recording CDs with perfect quality. The new bill which was prompted by an announcement by Marantz that it would start DAT imports provides for a years' prohibition but allows the import for professional use. An earlier bill providing for three year's operation was referred to the House Energy and Commerce Consumer Protection Sub-Committee last year and awaits the results of the NBS tests.

A further twist in reaction to the new bill is that the US Home Recording Rights Coalition which had agreed to contribute to the cost of the NBS tests is threatening to renege on payment.

Cruising in Style

The 1988 Ford Lincoln-Continental is to include a Sony Digital Audio Tape player in its audio system. The reasons advanced by Ford for the inclusion of a DAT player are for the quality of the system and the size and capacity of DAT cassettes. What the DAT player will use as software we couldn't find out from Ford.

The rest of the audio system is composed of an AM/FM cassette radio with stereo AM and FM and alternative analogue cassette deck. This system is wired to 10 JBL speakers and driven by a 140-watt amp with four 35-watt channels. The system was jointly developed by JBL and Ford, custom-designed for the Continental's interior space.

The DAT system will be offered instead of the currently available compact disc system.

Fine tuning digital audio signals requires some ingenuity.

TEAC's ZD circuit

DESPITE THE CLAIMS of many manufacturers, digital music reproduction in the form of compact disc (CD) or digital audio tape (DAT) players is not perfect. The specifications are impressive — 90 dB dynamic range, "immeasurable" wow and flutter,etc — but the fact is, that under real-life listening conditions, digital media can produce both noise and distortion that are significant enough to audibly detract from the quality of the sound. Once again, squeezing the last one per cent of performance out of an otherwise first-class reproduction medium has proven to be a formidable task.

A new circuit from TEAC goes some of the way towards claiming this last little bit. It's called the TEAC ZD circuit, and works by adding white noise to the signal. It was originally introduced in 1985 on the ZD5000 compact disc player. Now TEAC has released a second generation version of the circuit on its new models.

The Problem

The problem the ZD circuit is meant to attack is inherent in digital audio systems.

Figure 1 is a graphic representation of an analogue signal. The horizontal axis represents time and the vertical axis is amplitude. On a compact disc this signal would be recorded as a series of digital values which represent the amplitude of the signal at precisely-timed intervals.

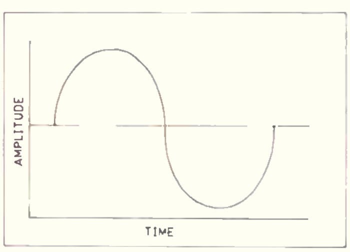


Figure 1: An analogue sine wave.

When the signal is reproduced on a CD player, the player's digital-to-analogue converter (DAC) converts the series of digital values read from the disc back into analogue voltage levels, thus recreating the original analogue waveform. Here's where the problems begin. Since the player is only given a series of discrete values to work with, the DAC produces a stepped reproduction of the original waveform, like the one shown in Figure 2.

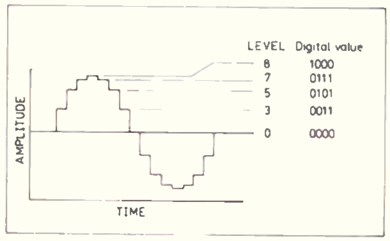


Figure 2: A theoretically perfect digital rendition of the signal in figure 1.

The steps thus imposed on the desired waveform are smoothed by filtration and, in some cases, oversampling, so you're left with a nice clean reproduction of the original signal.

At least that's how it works in theory. In reality there is a serious problem caused by the fact that with present technology it is impossible to produce a perfectly linear DAC. This means that it is not always capable of producing an output voltage that precisely corresponds to the input digital value. For example, while a linear input should produce a stepped output signal that looks something like Figure 4, it actually looks more like Figure 5. In Figure 5 the conversion steps do not precisely match the input data, thus adding noise and distortion.

For the most part, this non-linearity is but a small percentage of the total signal level. Practically, it is insignificant when reproducing large signals. However noise and distortion become unbearably large in relation to low-level, quiet signals. For example, a 0 dB input signal might produce a distortion level of only 0.003% but a −60 dB signal reproduced on the same player would have as much as 3% distortion. Reduce the signal level to −80 dB and you'd have 30% distortion.

Figure 3: A practical rendition of the signal in figure 1 after it has been treated by an analogue-digital converter.

It's not all that difficult to see why this should be so. The levels of signal voltage swing from zero through to the full level the DAC can handle. Non-linearity problems, on the other hand, are constant, and don't depend on the input level at all. Thus noise becomes a greater proportion of the whole as the signal level goes down.

ZD

So, what's the solution? One strategy tried by most manufacturers is oversampling. There's no doubt about it: oversampling does help in improving the reproduced sound of compact discs. However, it does not, for example, provide more accurate reproduction of the original signal or eliminate quantization error. Once a signal has been quantized at 16 bits and a sampling rate of 44.1 kHz, that's it. No amount of oversampling, 18 or 24-bit reproduction can recover signal details that were originally "ignored" between samples.

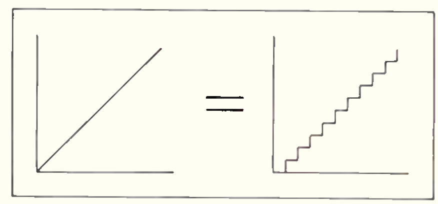


Figure 4: Linear output from a DAC means even tread on the step.

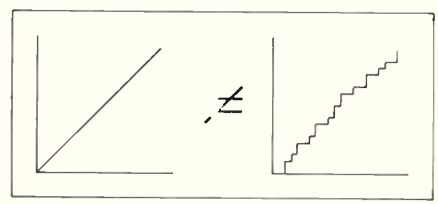
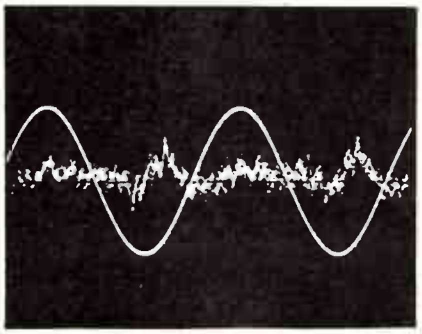


Figure 5: Practical difficulties produce this type of output from a constant ramp input.

TEAC's solution is to add some noise to the circuit. While the idea of adding noise with the aim of minimizing noise might seem contrary to common sense, the technology is very effective in practice.

A random pulse generator is synchronised to the sampling of the recorded digital data, and adds a random value to each



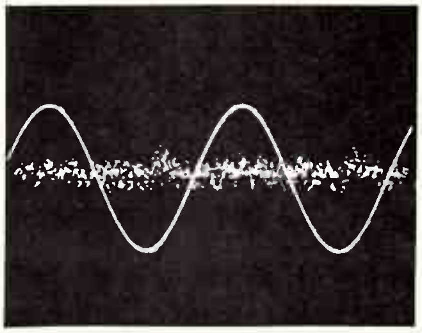


Figure 6: What it looks like in the time domain. These oscilloscope shots show the ZD circuit in action. At left, there is no dither, and noise peaks are clearly evident. At right, dither has been introduced and the peaks subside into the noise.

digital value received from the disc. The added noise is known as "dither". Both the music-plus-dither data and dither-only data are then converted to digital signals. After conversion, the dither noise is subtracted from the music-plus-dither signal, leaving only the converted music signal.

This has the effect of "randomizing" the inherently non-linear output of the DAC, thereby distributing the regular noise components to form white noise which does not appear as an integral part of the music signal.

In reality, the ZD circuit does not reduce the total amount of error produced by digital-to-analogue conversion. It changes it to white noise which is less audible and actually results in lower distortion.

In principle, the use of dither to reduce audible noise and distortion in digital reproduction systems has been known for quite a while. A similar principle is used in the analogue-to-digital conversion section of most professional digital recording equipment. The application of this technology to digital-to-noise analogue conversion in playback equipment, however, was not nearly so simple. It took years of research and development at TEAC to create a system which was capable of totally subtracting the dither noise from the music signal.

The use of dither in audio circuits is obviously not perfection, rather it is an acknowledgement of the imperfections that are inherent in using digital techniques to reproduce an analogue world. It may well become a standard requirement in all digital audio systems until DACs become orders of magnitude more accurate than they are at present.

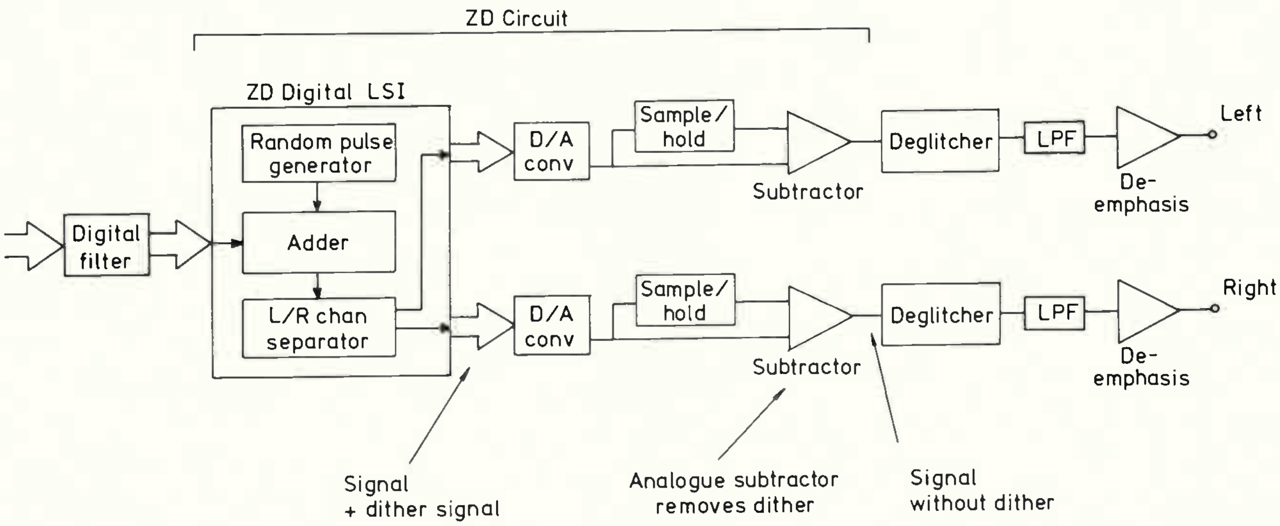
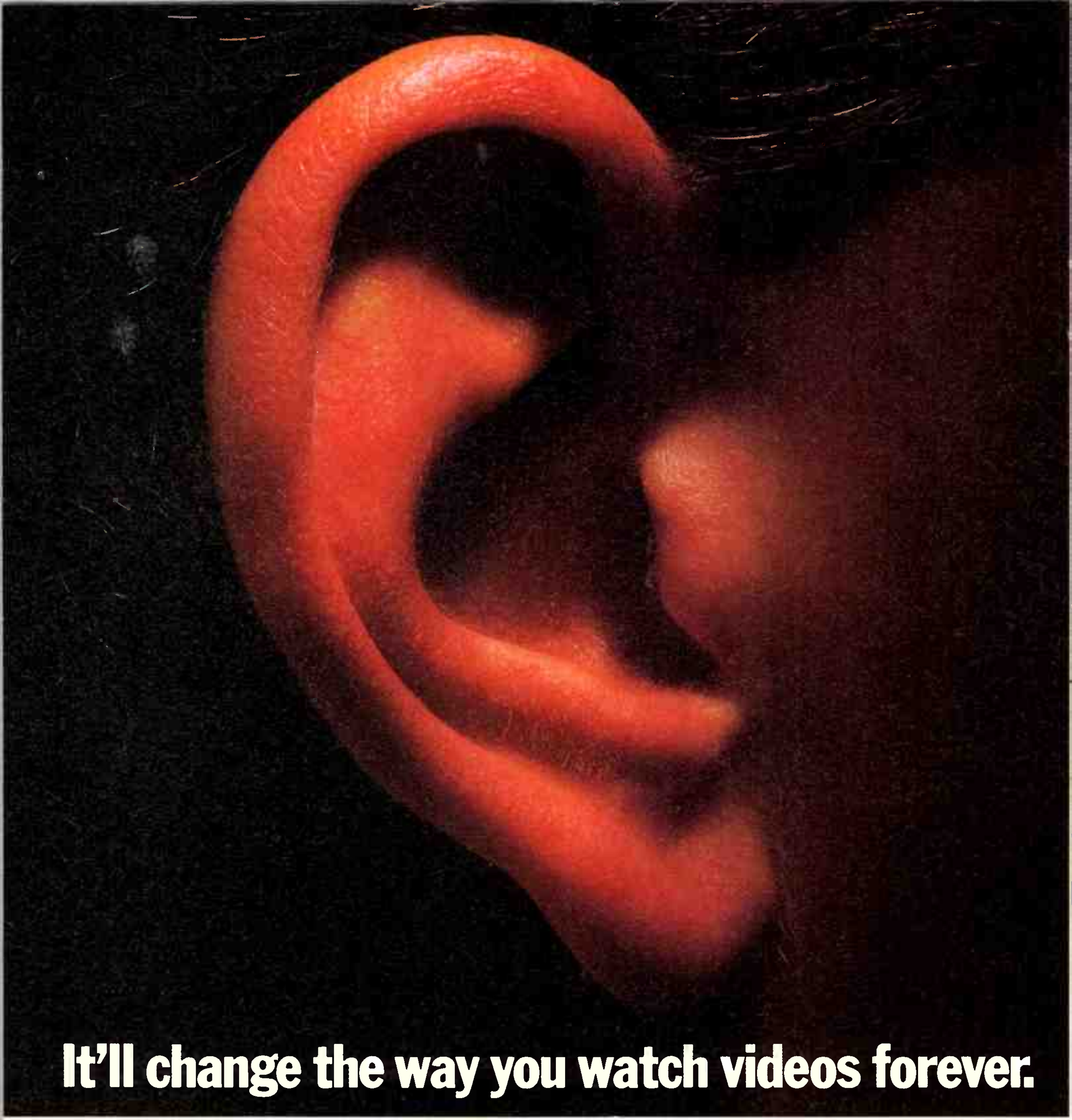


Figure 7: The complete ZD block diagram. At left, the signal enters from the disc. Random noise is added synchronised to the sampling of the DAC. After conversion, the random noise is subtracted and the digital noise removed in a low pass filter.


It'll change the way you watch videos forever.

The newest audio offering from Pioneer combines both sound and vision.

Pioneer's Model CLD 1050 Multi System Player

Les Cardilini

COMPACT DISC VIDEO (CDV) has at last arrived with the recent release in Australia of Pioneer's LaserDisc/Compact Disc/Compact Disc Video player, Model CLD 1050.

This follows earlier demonstrations of CDV players by both Pioneer and Philips in Australia, during December last year.

And, contrary to suggestions of a few years ago, that video pictures on compact disc when they arrived would be slow moving, slide-like presentations, CDV is full action video, with high quality, digital, stereo sound.

Compact Disc Video discs themselves are coloured gold so that they are distinguished easily from the now familiar, silver, audio-only version. Otherwise, the new CDV discs are the same shape and size as their silver counterparts and can, in fact, be played in existing CD players. It is anticipated they will sell at around the same price as regular, audio compact discs.

The catch is, of course, that in order to see the pictures and hear the video soundtrack on a CDV disc you need to have a CDV player and either a TV set or monitor and stereo amplifier. The CDV discs, however, also have about 20 minutes of conventional compact disc digital audio program without video, recorded elsewhere on the disc which can be played in existing CD players. A CD-only player playing a CDV disc simply ignores the six-minute or so video segment and its associated soundtrack, and plays the audio-only segment as though it were an ordinary compact disc.

Perhaps it should be made clear that there are two, separate sound programs on the CDV disc. One is the soundtrack belonging to the video. The other is up to twenty minutes of conventional, compact disc digital audio sound which is not necessarily related to the video sound track. The audio-only program and the Table of Contents (TOC) on the CDV disc are recorded in the innermost area where they can be read normally in a non-video CD player. Accordingly, the non-video CD player can start up and play the required tracks in the conventional CD area of the CD video disc and will turn off before it reaches the video tracks. The CDV player, on the other hand, learns from the TOC that a video segment exists on the disc, and then begins to play in that area unless the audio program has been pre-selected.

The video segment is recorded on the outer part of the CDV disc which, in the video mode, is sped up to about 2200 revolutions per minute in order to accommodate the large amount of video signal information. The higher speed accounts in part for the relatively short video program capacity of the 12 centimetre disc, compared with 60 to 70 minutes of music recorded at the regular CD disc speed of 200 to 500 rpm. Also, there is considerable area remaining towards the centre of the disc, inside the video recording area. It seems that to record video information any closer to the centre of the disc, even at the increased speed, would create impractical information densities on the disc. Thus, there is space remaining between the video segment and the centre of the disc, sufficient to record a 20-minute, audio-only segment using the regular CD format at the lower speed.

Both video and audio-only segments on CDV discs operate at constant linear velocity (CLV). That is, disc rotation is slower when the laser pickup is reading outer tracks and faster when the pickup is nearer the centre of the disc, in each mode.

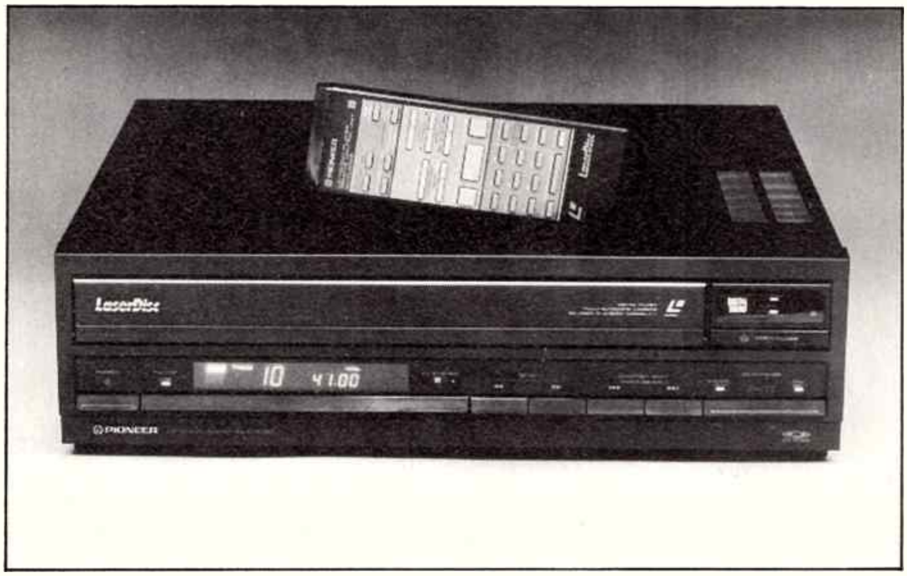
The Pioneer CLD 1050 player is not unlike other component-type CD players but is, perhaps, deeper than most. Its wider disc tray, which slides open at the touch of a button, will accept 12 centimetre, 20 centimetre and 30 centimetre discs, in moulded rings which centre the respective discs in the tray for playing.

As the disc tray is closed, the player automatically senses both the size of the disc and in which of several laser disc formats it has been recorded, and prepares to play the disc.

This includes chucking, or coupling, the disc onto one of two spindle motors, bringing the motor up to the correct playing speed and controlling disc rotation according to constant linear velocity or constant angular velocity rules, depending on the kind of disc being played at the time. It then indicates on the front panel display the kind of disc format it has detected and whether the sound is digitally encoded.

A separate spindle motor is used for playing 12 centimetre diameter CD and CDV discs, and is located slightly to the rear of the spindle and motor assembly used for the larger discs. The CD/CDV motor rotates, or lowers, automatically into a horizontal position where it is out of the way when the larger, 20 and 30 centimetre laser video discs are playing, and returns automatically to its upright playing position when a 12 centimetre disc is loaded. A single laser pickup is used in all playing modes.

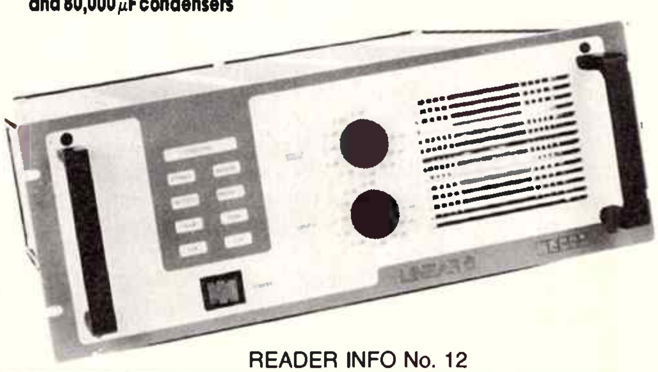
Controls on the front panel of the CLD 1050 have been kept to a minimum and it is really not until the cordless infrared remote control is examined that the full operating features of the CLD 1050 are apparent. Pushbuttons on the remote con-

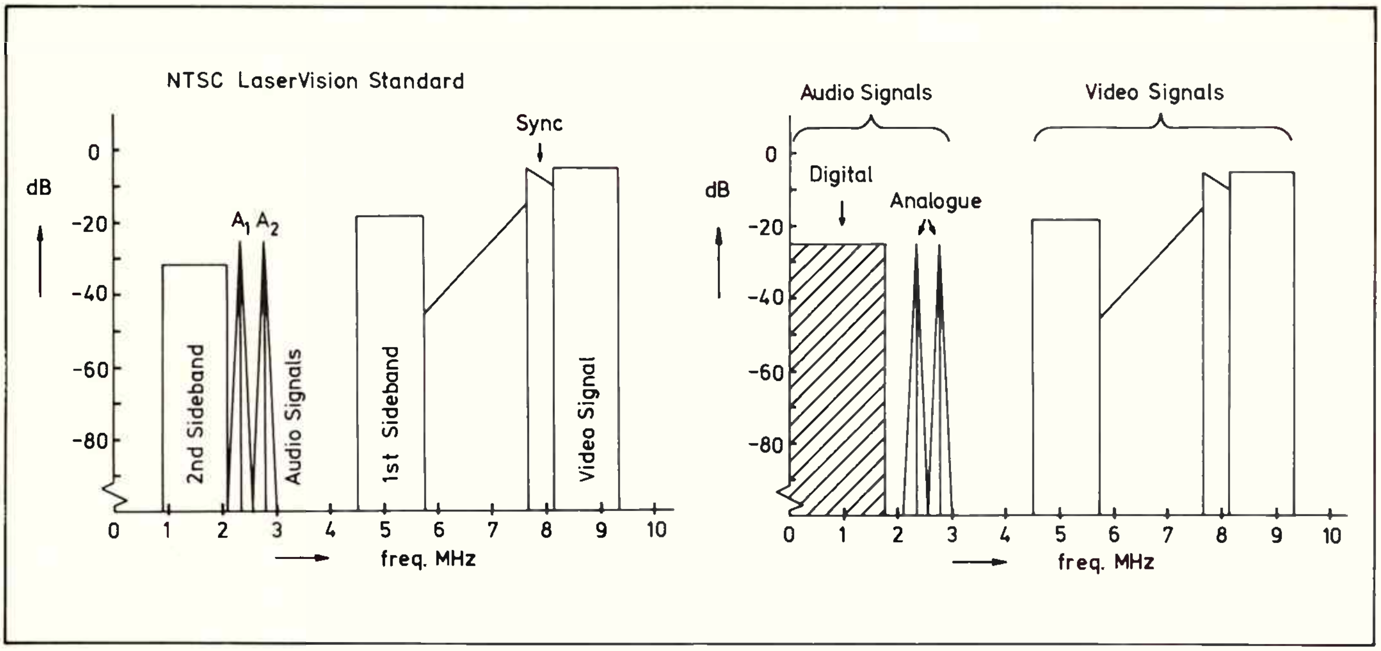


trol unit have dual functions depending on whether the set is playing in the CD-CDV, or LaserDisc mode. Music tracks on CD/CDV discs, and chapters (segments on video discs) may be programmed or cancelled using the remote control, and the disc may be scanned or searched in various modes depending on the kind of disc being played. A display function initiated by the remote control brings up or cancels the front-panel display, or on-screen information about playing time, track or chapter numbers and segment repeat data.

The Pioneer player automatically handles all disc versions and sizes in the PAL LaserVision system, as well as regular compact discs and CDV recordings. Video outputs are provided via BNC connectors and SCART, or Euro connectors, and a PAL TV RF output is available on UHF channel 32 or 40, adjustable. A TV antenna input is also included on the CLD 1050 and is automatically switched through to the TV set when the player is not playing video discs. Stereo audio is connected out of the CLD 1050 via the SCART connector and also through a pair of RCA sockets. The player should be readily accommodated in home systems where there is a UHF TV set available. As well, of course, the sound from the CLD 1050 may be connected to a stereo amplifier and speakers.

Recommended retail price for the Pioneer LD/CD/CDV Player is $2599. Further information about Pioneer products may be obtained from Pioneer Electronics Australia Pty Ltd, 178-184 Boundary Road, Braeside, Victoria 3195; telephone (03) 580-9911. ●





Videodisc specifications:

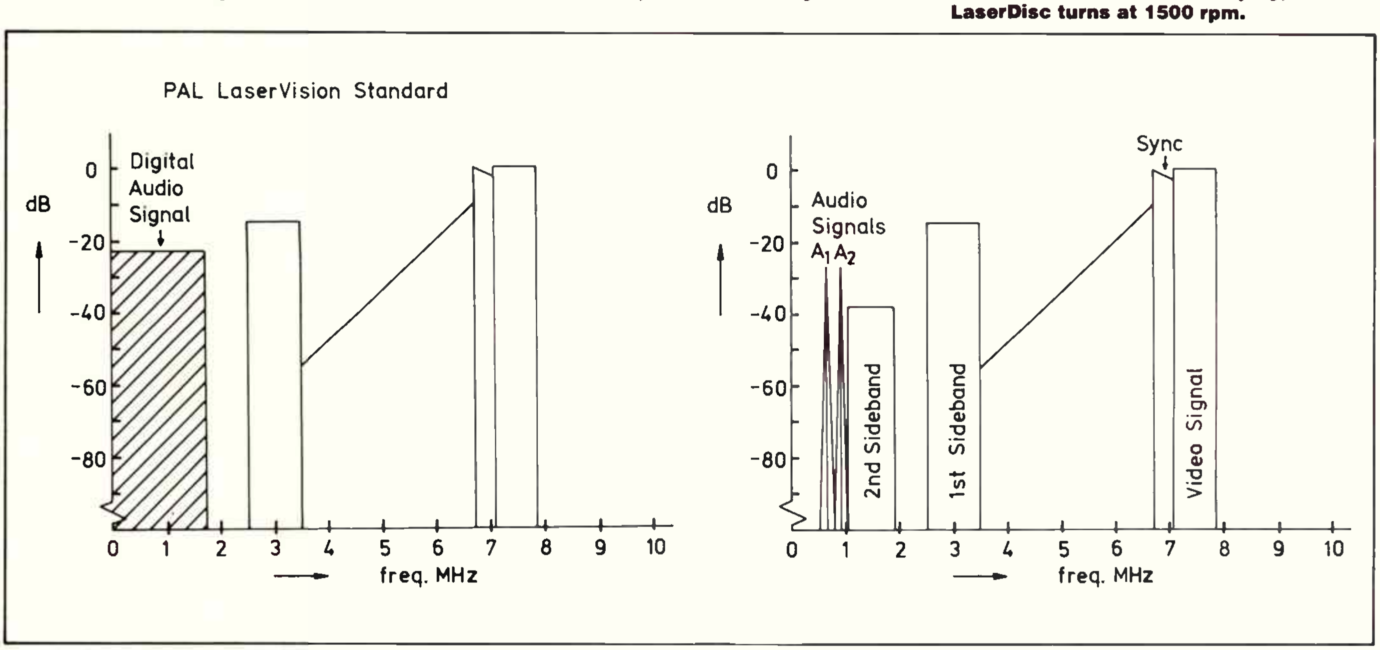
There are both PAL and NTSC LaserVision systems. Different methods are also used to record the stereo sound associated with the video. Some laserdiscs, have both analogue and digital sound but these are mainly NTSC versions.

In the NTSC LaserVision system, the modulated video carrier spectrum and both analogue audio subcarriers and their sidebands are contained above 2 MHz leaving room to accommodate stereo audio encoded in the CD data format. In the PAL system the wider video bandwidth and accompanying left and right audio channel signals extend well below 2 MHz, presenting the option of encoding the audio channels in either analogue or digital form but not both.

As a result, NTSC LaserDiscs may be found to have analogue or digital or both forms of sound modulation while PAL laserdiscs may have analogue or digital sound but not both. In both formats the video carrier is frequency-modulated and the analogue sound information pulse-width-modulates the video carrier. When digital audio modulation is used the formatted data is NRZI-encoded and shifts the dc level of the video carrier accordingly. PAL Compact Disc Video sound is digitally encoded on the disc.

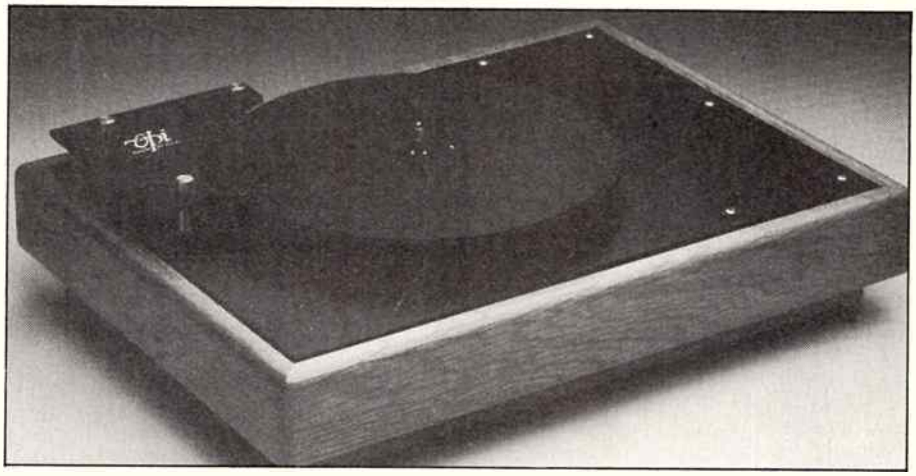
A further distinction still may be made between laser video discs. On the one hand, the track may be recorded at a constant linear velocity (CLV) while, on the other hand, a laser video disc may be recorded at constant angular velocity (CAV) in which case each revolution of the disc takes one PAL TV frame period. Thus, video frames are arranged in concentric tracks onthe disc.

More playing modes such as stills and slow motion can be readily incorporated into CAV discs but less playing time is available compared with CLV discs of the same size. The two systems may also be referred to as *active*, and *long-play*, respectively. The long play, CLV LaserDisc turns at 1500 rpm on the inner circumference and slows to 570 rpm on its outer circumference. The active play, CAV LaserDisc turns at 1500 rpm.



In an age of CD and DAT, not to mention analogue cassettes, is there still a place for the humble turntable?

Turntables



The HW-19 Mk II from VPI in the US is typical of many modern high end turntables. It uses a lead weighted platter to reduce speed errors and a special isolation base to restrict resonances and rumble. The platter rotates on a Tungsten Carbide bearing. READER INFO No. 31

Turntable technology was a victim of progress. Just as electronic control systems were developed that could have reduced wow, flutter, rumble and all the other colourations that plagued even the best turntables, digital music broke onto the scene and swamped turntable technology. The salad days never really arrived, and the music scene is probably the poorer because of it.

Over the years, turntable manufacturers developed an understanding of the art of building these devices so that, using mechanical means, they could make a turntable conform to extremely precise performance figures. In a mechanical sense the numbers were impressive, even if, in an age of digital electronics, they were sadly lacking.

Today, the turntable is still in production, and still the favoured source of many an audiophile. Within the last ten years, typical performance figures have improved perhaps ten fold, giving a more accurate sound than before. Here we look at some of the design problems the modern turntable manufacturer has overcome.

Speed

The fundamental task of any turntable is actually to turn; what's more, to turn at a precisely defined speed.

Until recently, it was acknowledged that if the rotational speed of a turntable (33⅓ rpm for LP records) was accurate to around 0.1 per cent it was very good. With the arrival of quartz controlled turntable drives however, speed accuracies in the order of 0.025 per cent are possible.

However, this degree of accuracy is not of any real advantage because, provided the speed is constant, even a musically trained human ear will rarely be able to hear a speed error of less than 1 per cent. Speed accuracy is much touted by the CD lobby as one of the great advantages of the digital format. It is actually quite irrelevant.

Accurate speed is not as important to the listener as variation in speed.

Speed variations about the constant speed may be fluctuations of low frequency (1-10 Hz), in which case they are called wow; or of higher frequency (over 10 Hz), in which case they are called flutter.

The human ear is most sensitive to wow and flutter when listening to tones at around 1 kHz (i.e: the mid-range), and virtually all speech and music programme material is centred there. In practice, wow and flutter fluctuations of anything over 0.1 per cent may be audible to some listeners with musically trained ears and most people will be able to hear fluctuations of 0.25 per cent or more.

One point easily overlooked is that what really matters is how the turntable unit performs under load, that is when a disc it carries is being tracked by a cartridge stylus. When loud recorded passages are being tracked, drag is imposed on the turntable. Its drive mechanism must be able to override this so that its speed does not vary according to the music being played. It is in fact possible for a turntable to have an excellent measured performance but wow audibly when actually required to play loud music!

Rumble

A third noise source in a turntable is rumble. Rumble is mechanically generated by the moving parts of the platter and drive motor. It can be pitched anywhere between 2 Hz-1 kHz and, to be unobtrusive, it must be at least 65 dB below the average level of programme sound being reproduced.

The Tone Arm

The turntable proper consists only of the mechanism necessary to turn the record around. It's a pretty useless piece of gear without the tone arm which presents the stylus to the record.

The specifications for the tone arm are impressive. It must have freedom of movement across the record surface, i.e: in a horizontal plane. Because the arm must be able to play records of varying thicknesses, and cope with warped rather than truly flat pressings, it must also have movement up and down, i.e: in the vertical plane.

There are two ways in which the arm can enable the cartridge and stylus to track across the record surface.

The first method is called parallel tracking. The cartridge is mounted at the end of an arm which slides along a guide rod, so that the cartridge and stylus are free to move only in a straight line direct from the edge to the centre of the record, i.e. along the radius of the record circle. For this reason, parallel tracking is also sometimes called radial tracking.

In theory, such radial movement could be automatic, the spiral groove physically carrying the stylus and cartridge with it towards the centre. But, in practice, the tiny groove is just too small to drag the arm across the disc, and along the guide rod with any degree of reliability, and without causing distortion of the reproduced sound. For example; in pulling the arm along the rod towards the centre of the disc, the stylus will inevitably drag heavily along one side of the record groove. This causes either, excessively loud reproduc-

Jonathon Powers

Two turntables from the Japanese Yamaha Music that use a two piece design for the platter. The two materials are chosen so that the resonance frequencies are different. The PF 800 (right) uses zinc and aluminium, while the PF 1000 uses gun metal and aluminium. In a rather cunning innovation, the belt drive is coupled to the inner of the two pieces, so that the effective inertia of the platter is increased without increasing its mass. This reduces flutter considerably. READER INFO No. 32

tion of the signal on that groove wall and consequent stereo imbalance, or damage to the groove wall, or, more likely, both.

For this reason, a power drive for the arm is necessary, so that it moves along the rod from disc edge to centre of its own accord. But this in turn presents problems, because the power drive must be sufficiently precise to ensure that the stylus does not press unduly heavily on either groove wall, and be able to cope with different groove pitches (because the spacing of the grooves on a modern LP record varies with the volume of sound recorded). The drive must also cope with a disc pressing in which the spiral is slightly eccentric. Sophisticated servo control systems are necessary to ensure controlled movement of the arm, cartridge and stylus over the disc surface. It is for this reason that parallel or radial tracker turntables are both uncommon and expensive. They can, however, produce high quality sound if well engineered.

A much simpler approach to carrying a cartridge across the record surface is to mount it at the free end of an arm which is pivoted and counterbalanced at the other end. In this way, the cartridge is carried in a sweep across the record surface, along an arc centred on a fixed point. This, of course, is the conventional type of pick-up arm with which we are all familiar.

Because the groove in the record you buy was pressed from a master disc cut with a parallel tracking arm, it cannot be accurately tracked by an arm sweeping around a fixed pivot. With a parallel tracking arm, the axes of the cartridge and its stylus always lie truly tangential to the groove spiral, whereas the cartridge of a pivot arm can only lie truly tangential to the groove spiral at one point of the arm's sweep into the centre.

The geometrical error introduced elsewhere in the sweep is called tracking error. It is in fact far less important than might, at first, appear. It can be made insignificant by careful design. But clearly, to achieve geometrical accuracy in this respect requires that the arm pivot be located at a carefully considered position on the turntable plinth with respect to the centre spindle of the platter.

The fixed pivot arm sweeps in from the edge to the centre of the record under power generated by rotation of the record and continual contact of the spiral grove with the cartridge stylus. An ideal arm would thus have, among other features, effectively zero mass and zero friction in the horizontal and vertical directions, so that the cartridge and stylus were effectively floating in space.

But of course this is impossible. Apart from anything else, a downforce is needed to hold the stylus in the groove and keep it in sufficiently pressured contact with the undulations on the grove walls in order to generate electrical signals in the cartridge. These must correspond accurately to the movement of the stylus over those groove walls. As one would expect, a complicated set of compromises has to be reached.

Because the cartridge must have freedom to move in two planes, horizontal and vertical, there are two components of friction which need consideration. It is a fact of physics that whenever any two bodies move relative to one another there is friction between them. The main source of friction in an arm is the bearing which gives the arm its freedom of lateral and vertical movement, i.e: the pivot bearings.

Essentially, the better quality the bearings the less friction they will exhibit. And generally, the less the friction the better the arm will perform, because whatever friction exists in the bearings will limit the ability of the cartridge stylus to follow the groove across the record, and to move up and down with any warp. The practical effect of an arm with too much friction will be that the cartridge mistracks — meaning that the stylus will not follow the groove accurately, will try to cut corners, and produce a distorted sound. In general, designers aim to keep friction at below one-twentieth the tracking weight of the cartridge, that is to say, if the recommended tracking weight is 2 grams, friction should be no greater than 100 milligrams.

What really matters for performance is the effective mass of the arm, rather than its actual mass. The actual mass of an arm and cartridge combination is the weight that would register if it were removed from the pivot and placed on a pair of scales. The effective mass is the load or drag which is 'felt' by the stylus. In addition to the actual mass of the arm, the stylus will also feel any extra load created by additional components. This can include any mechanical resistance created, for instance, by auto stop mechanisms or electrical connections pulling, on the arm from where they run to the plinth. Generally, it is good policy to keep the effective mass of the arm as low as possible. There is, however, nothing inherently good or bad about high or low mass because there is another important and interrelated consideration — resonance.

Resonance

So far we have described, noise sources caused by the inadequacy of the mechanical control. This is by no means the only source of noise however. Because it's a mechanical system, a turntable and arm can also suffer from resonance.

Every object has a resonant frequency. If you trap a solid object, it will 'ring' at a fixed pitch — that is its resonant frequency. A hollow box or cabinet is tuned to a pitch dictated by the enclosed volume. It follows that all parts of a record deck have resonant frequencies. And it also follows that if the resonant frequency of one part corresponds with the resonant frequency of another, there will be an unnatural predominance of unwanted sound at that frequency. The cumulative and combined effect of all this is generally referred to as 'colouration'.

Resonance can be damped, but only partially. Thus, just as you can damp the panels of a car door to make them 'drum' less during driving, so you can damp the platter and structure of a turntable either, by making it of a heavy substance or by adding extra material. A heavy platter also helps the motor to rotate it at constant speed, because the platter then acts as a flywheel. A good deal of the improvements to the overall performance of turntables in the last twenty years has been achieved through the use of heavy platters. However, there are limits. You can't overdamp a platter, but if it becomes too heavy, it will impose excessive strain on the bearings and will also increase its start-up time. In any event, nothing can be completely damped.

New material technology has helped here. The latest generation turntables use Tungsten Carbide and stainless steel to provide extremely hard, smooth surfaces for bearings, which allow lead platters to be used. In some units, the platter weight approaches 20 kg.

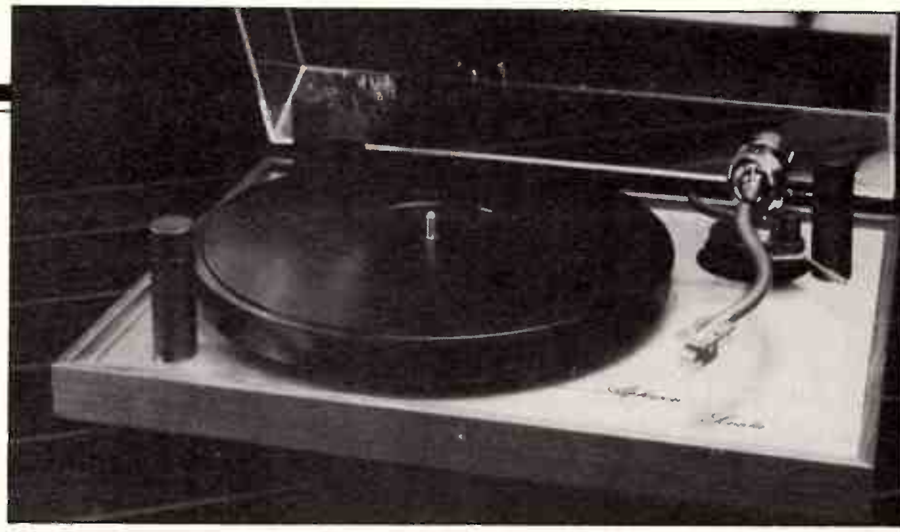
Another approach is to make the resonances non-additive. What the system designer does is simply ensure that the resonances of different parts of the deck do not coincide with any other resonant frequencies in the unit. This isn't as easy as it sounds.

The resonant characteristics of the turntable unit may not be determined simply by the resonant frequency of the structure on its own. It is, for instance, necessary to mount the motor of a belt or rim drive unit resiliently, on some kind of spring device perhaps. This is to prevent mechanical vibrations reaching the platter and causing rumble. Likewise, it is necessary to isolate at least some of the parts of the deck from vibrations in the environment. If this is not done, then the cartridge stylus may be physically bounced right out of the record groove, or the sound of the various vibrations picked up and reproduced through the loudspeakers.

Not only may this create a vicious circle of sound and acoustic feedback and introduce audible distortion of the reproduced programme, it may also physically damage the loudspeakers. Many high powered modern amplifiers are capable of feeding signals to the loudspeakers which are of such low frequency that although they are inaudible, can physically damage the cone suspensions of the speaker units. Low cut or subsonic filters are often provided on amplifiers, to help guard against this risk.

There is also resonance in the tone arm. When the stylus rests on the record groove, a spring-like combination is created. The arm and cartridge can move up and down with the record, while the stylus remains in the groove, due to the flexibility of the cantilever, which is the only connecting link between record and arm. Any spring system, of course, has a resonant frequency.

The resonant frequency of the arm-cartridge-cantilever-stylus-disc combination depends largely on the effective mass of the arm and cartridge. Thus, the effective



Alphason's Sonata began life as a test bed for the company's HR100S reference pick up arm. The Plinth is hardwood and the platter heavily damped with added weights.

READER INFO No. 19

resonance of an arm will depend to a considerable extent on the type of cartridge with which it is fitted, some cartridges being heavier than others. Also, different cartridge cantilevers have different flexibility. It should, however, be clear by now that to ensure that the resonances of a turntable unit do not coincide with the resonance of the arm requires careful consideration of several factors. It also becomes easier to see how some arm-cartridge-turntable combinations can be more prone to resonances than others.

Resonance from this source is usually subsonic at around 10 Hz. If the resonance is put too low, the combination will be very susceptible to external shock, for instance room movements. The cartridge and stylus will then be likely to jump out of the groove as you walk round the room. As a general guide, such dangerously low resonances stem from high mass arms used with high compliance cartridges (with soft sprung cantilevers). To raise the resonant frequency above these dangerously low levels requires that the effective mass of the arm be reduced, or the compliance reduced (i.e: the cantilever made less springy) or both.

This presents problems, because there is obviously a practical limit to how much you can reduce the effective mass of anything. Also, low compliance cartridges are incapable of tracking difficult programme material such as loud musical sounds, because the cantilever is too stiff to let the stylus follow the groove excursions. If the resonance is put too high, it will move dangerously close to the audible frequency spectrum and colour the reproduced sound. As a general guide, one reasonable arrangement would be a turntable unit with a chassis resonance of between 2 and 4 Hz and an arm-cartridge-stylus-disc resonance of around 7 Hz or higher, i.e.: around 9-11 Hz. This will leave the record deck reasonably immune from room vibrations and the arm will be able to track warped records without resonating at the frequency of the warp (always below 10 Hz and usually around 6 Hz). The two resonances are also sufficiently widely spaced apart to be independent and act in effect as a combined filter for mechanical vibrations.

Subsonic resonances can be damped in a variety of ways. One technique is to connect the counterweight on the end of the pick-up arm to the arm by rubber material. An alternative is to use a viscous fluid encased around part of the arm. Properly applied, such damping techniques can control the otherwise unacceptable resonances of a high mass arm. Used clumsily, however, they can create other problems, for instance increasing friction and thereby impairing tracking and causing audible distortion. Another, more subtle risk, is that the damping material, will itself serve as a spring and create a secondary resonance of its own, possibly in the higher and thus audible frequency range. This will make the arm ring audibly at the resonant frequency and colour the sound like a bad loudspeaker. But arms may have audible resonances purely as a result of basic bad design.

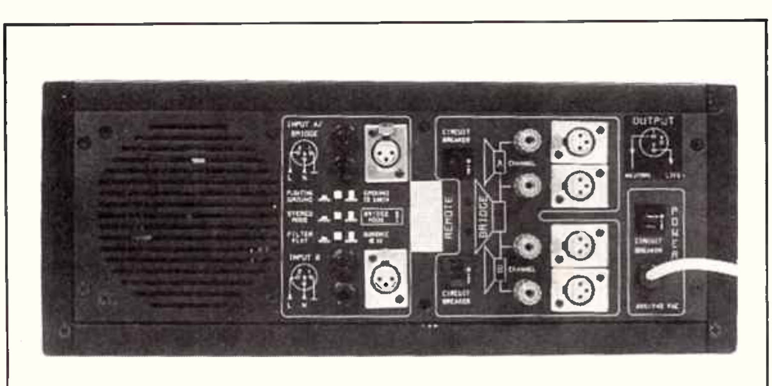
The use of such techniques has meant that the moden turntable is able to deliver a quality of audible signal substantially better than was formerly the case. In many respects it lags behind the CD player. It will never achieve the wow, flutter or rumble rejection of the CD player, nor does a CD player have to contend with anything like the resonance problems of a turntable.

However, modern design has reduced these attributes of the turntable to a level where they are insignificant. Of more significance now are the digital problems of CD players. ●

Louis looks at the Hertz Linear 62 amp and finds it potent.

Louis Challis

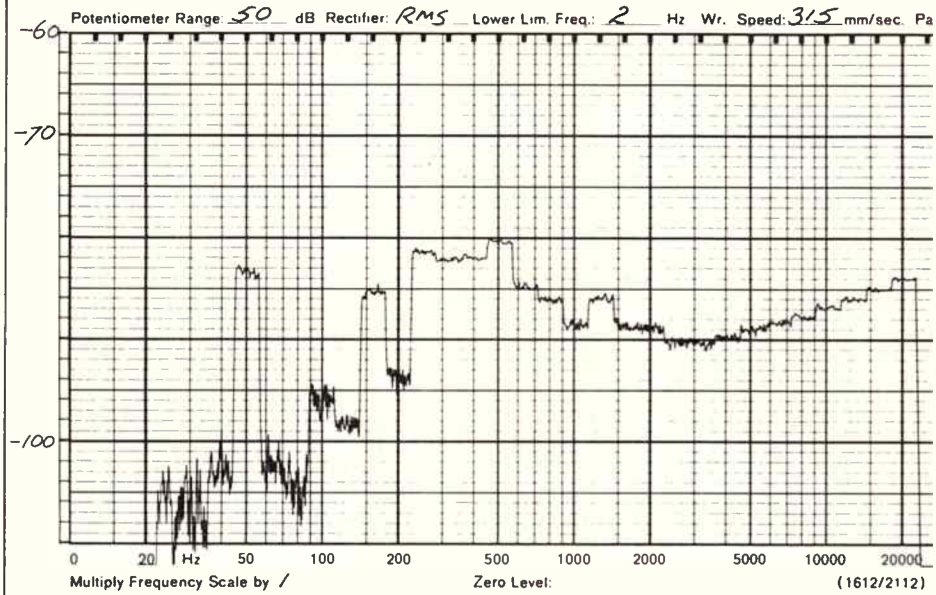
Hertz Linear 6.2



THE HERTZ LINEAR 6.2 power amplifier is the first imported high performance amplifier we have seen from Germany. It is in many respects a different type of unit to the Australian, New Zealand and American amplifiers with which we have become familiar, in either the hi-fidelity or PA fields.

Visual Difference

The first difference becomes obvious when you look at the front panel. The appearance is generally more 'high-tec than most other comparable amplifiers, and also has



Hum and noise in the Hertz Linear 6.2. The Auxiliiary inputs were short circuited for this test and measurement is re 1 watt into 8 ohms.

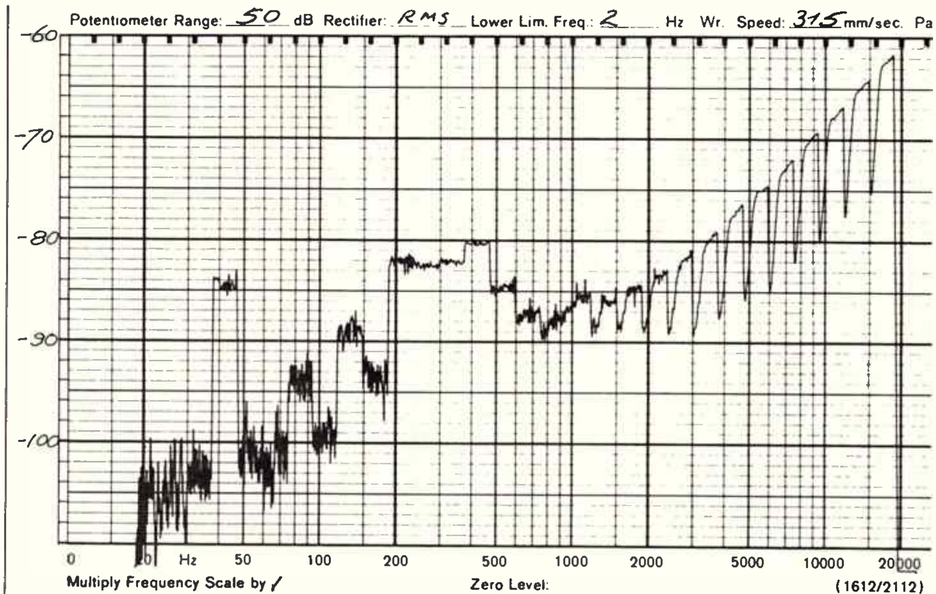
a number of 'user friendly' features which will endear it to its users. Apart from the neat, smooth and practical black-die-cast handles at each end of the front panel, it incorporates a neat escutcheon which provides important operational data.

The rear illuminated bezels provide data on the selection of sub-sonic filter, whether the amplifier is in the normal stereo or bridged mode, whether the protection circuits are operating, whether the temperature has risen above the pre-determined limit, and whether the amplifier is clipping on the output. At the bottom of the panel is a large self-illuminated power switch, whilst in the centre of the panel are two convenient, rotary, knurled attenuators with click steps of infinity, 30, 20, 15, 10, 8, 6, 4, 2 and 0 dB attenuation for accurately setting the amplifier's output.

One criticism that I have is that, although there is a raised step on each rotary controls to show where it is pointing, it is not readily visible. This should either be grooved with a white spot, or provided with some other more direct visual indication. On the right hand side of the front panel are a series of 125mm long, 3mm wide slots which provide effective protection for the fan cooled transistor cooling duct system, which serves the cabinet and the output power stage located immediately behind. The top and bottom slotted steel panels ensure enhanced cooling of the circuitry whilst the back of the amplifier has a matching series of slots through which the whisper quiet fan exhausts the hot air from the cooling duct.

The Back Panel

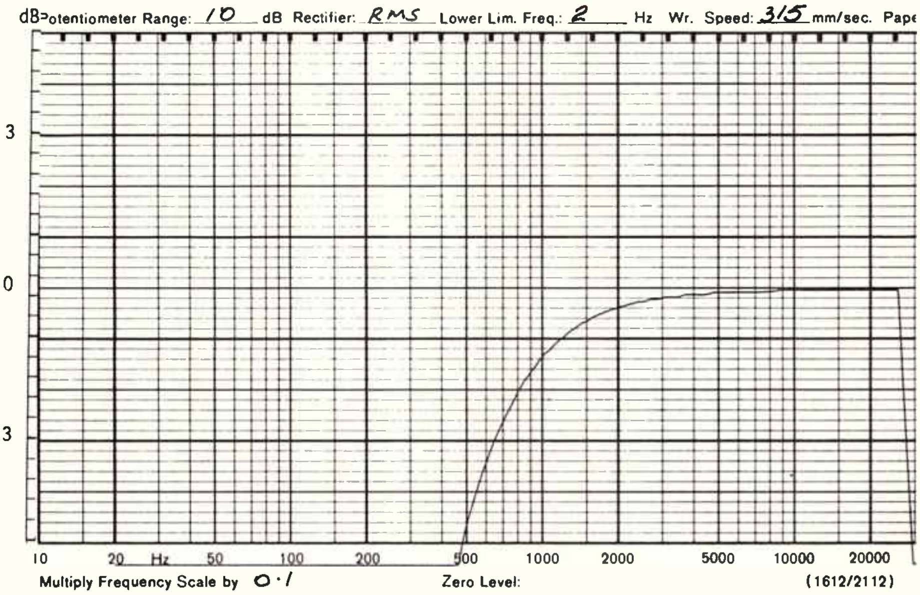
Whilst the front of the panel provided a neat appearance because of the minimal numbers of controls, the back panel has a far greater number of facilities and has a 'busy appearance'. Most of these controls would require minimal adjustment, except during the initial set-up. The connections to input and output circuitry are completely separate and, much to my surprise, the configuraiton of sockets are different from most Australian and American amplifiers. The signal inputs are provided by two separate parallel tipped and sleeved phono sockets together with a female Canon socket. One set of sockets is placed at the top for the A (left channel) and one set of sockets at the bottom for the B (right channel). In the middle of these socket banks are three switches which provide for isolated ground or earth grounding, a stereo mode (for separate amplification) or bridging mode switch, which allows the two output circuits to be interconnected. In this mode, the amplifier provides almost double the output power. The last control on the back panel is an input filter switch which provides a 25 Hz half power point in the flat position and moves it to 61 Hz when selected.

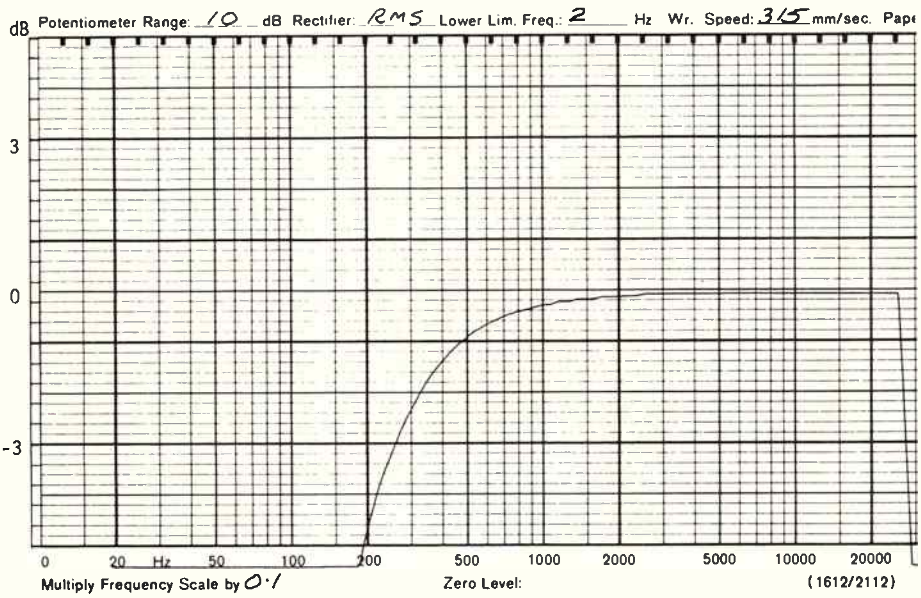


Crosstalk. The other channel was fed with a 0.5 Vrms sine wave, the input of this channel was short circuited and the recorder applied to its output, in order to produce this graph of crosstalk. The numbers are excellent when applied to comparable units.

The output circuitry connections on the left hand side of the rear panel feature a vertical stack of four very large Universal terminals with matching pairs of female Canon sockets for both the A and B outputs.

This combination of sockets is unusual by Australian Standards, where most of





Frequency response. The top trace show the response with the input filter applied. At bottom the input filter is removed. The horizontal axis should be multiplied by 0.1 to get the correct frequency. Although the graph shows a smooth roll off with no nasty side effects, the numbers are substantially different from those in the manufacturers specifications. The filter has no perceptable effect on the response byond about 200 Hz.

our amplifiers have male sockets (which of course have exposed terminals) with peak-to-peak voltages of up to 150 volts readily achievable at a relatively exposed position. By contrast, the German VDE standards do not permit the use of male sockets and, consequently, the Germans conform to the safety requirements by using female sockets which avoids the potential risk. Each of the output circuits is provided with its own independent circuit breaker with neat AMP relays with magnetic spark supression. The mains power circuit is similarly protected, as a second line of protection.

Inside Circuitry

An examination of the inside circuitry reveals that the unit has been constructed to very high professional standards. The first thing I noticed was the extremely large toroidal power transformer near the front of the board, whilst the large electrolytic capacitors have extremely heavy solid copper buss bars interconnecting the individual cans. The conventional wiring is neatly laced with push fit connectors, which, in most cases, utilise relatively short links to minimise stray capacitance, and flexible elements which can break off as a result of premature fatigue. The circuitry is well layed out on epoxy glass pc boards. The unit and its method of assembly has obviously been designed to provide ease of maintenance and simplified checking, or card swapping in the event of circuit problems. The electronic circuitry makes extensive use of high quality 1% metal film resistors, encapsulated polyester and polypropylene capacitors, ribbon feeder cable and laced wiring harnesses utilising thick low impedance cables for stable and solid circuit connections.

The chassis and fittings are solidly constructed and designed to withstand reasonable amounts of professional abuse.

The objective testing of this amplifier provided considerable data, some of which did not necessarily agree with the manufacturer's published lierature. The one obvious variation related to the low-pass cut-off frequencies of the amplifier, which our testing showed to be 25 Hz for 3 dB down and 61 Hz for 3 dB down, for filter-out and filter-in, respectively.

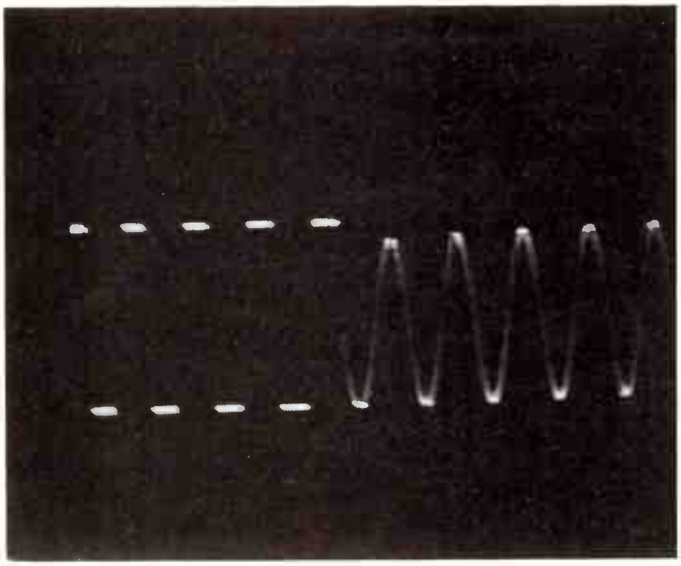
The manufacturer's literature claims that these frequencies occur at 18-40 Hz, with the input filter. These results are still, however, quite acceptable as they would provide useful infra-sonic protection. The other important characteristics of the amplifier such as sensitivity, input impedance, output impedance and signal to noise, all conform well with the manufacturer's data, especially in respect of output power output capability into both 8 ohms and 4 ohms, which is achieved without any loss.

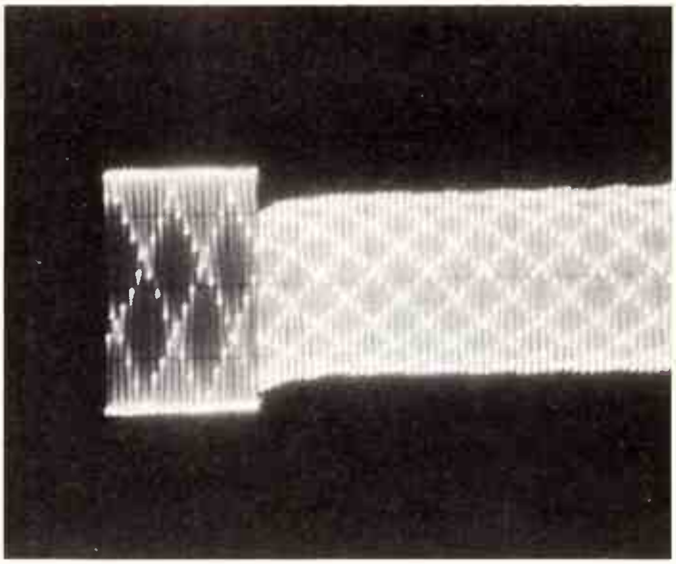
The distortion characteristics of the amplifier, both at the 8 ohm output level and at the 4 ohm output level, are exceedingly good at frequencies up to 1 kHz, but start to rise significantly in the higher frequency range, where distortions in excess of 1.0% are readily measurable. The h_{fe} of the output transistors thus appears to be a function of operation frequency.

The distortion characterisics measured by the 'HEC high frequency total difference frequency distortion' procedure reveals a smooth and gradual rise of distortion up to 0.1% at 100 volts peak-to-peak

DIMENSIONS

Height	177mm
Width	483mm (19" Rack)
Weight	21 kg
Depth	350mm
RRP	$3,800





Transient Ovberload recovery as senn on an oscilloscope screen. At the left the scale is 1 mS/div. At the right its set to 50 mS/div. Both channels are driven during the test.

output. These figures start to rise fairly rapidly once the power level exceeds 150 volts peak to peak output.

The maximum output voltage (at the clipping point) is 155 volts peak-to-peak into 8 ohms, and 150 volts peak-to-peak into 4 ohms, which are excellent results. The unit can deliver in excess of 1350 watts into 8 ohms in the bridged mode which is a very healthy output.

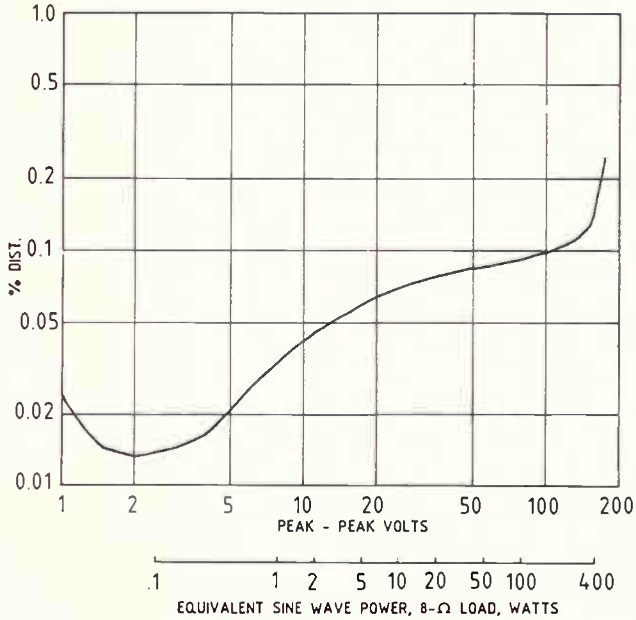
Another excellent parameter is the channel separation which is better than 80 dB at all frequencies up to 4 kHz, and still better than 62 dB at 20 kHz. The unweighted signal to noise ratio is 71.5 dB at 1 watt and is better than 75 dB(A) re 1 watt into 8 ohms. The transient overload recovery test is good but it reveals a slight trace of assymetry as the attached photos conform.

Subjective

I connected up a new CD player, the Sony CDP-555 ESD, directly to the inputs of the Hertz Linear 6.2 Amplifier without the benefit of a pre-amplifier and connected the outputs to a pair of Fisher monitor speakers which are capable of handling a continuous input of 300 watts or more. For the subjective evaluation I selected three exciting new discs which were Cristina Ortiz playing *French Impressionist Piano* pieces PCD 846 from Virgin Records. The quality of sound produced was absolutely superb, as all my neighbours can now atest. I followed this up with Knud Vad playing *J.S. Bach Organ Concert* and particularly the *Fugue in G. Minor BWV578* on Denon 33CO-1590. This particular piece shook the house from end-to-end with organ music, the only catch being that I don't have an organ. The quality of sound and the quality of music was breathtaking. The amplifier was quite happily producing peak sound pressure levels in excess of 115 decibels at my listening position.

The last set of discs that I played in my assessment were Richard Meale and the Australian Opera *Voss*, Philips Digital Classics in a 2-compact set 420928-2 which has been recently released under the auspices of the ABC and Philips.

The Hertz Linear 6.2 may have been designed primarily as a PA amplifier, but it can provide outstanding service as a hi-fidelity amplifier. As hard as I tried to blow-up the output stage or overload it, I didn't really succeed and found it difficult to get anywhere near the point where the overload protection circuits would trigger. The Hertz 6.2 is a rugged and potent amplifier and should attract many intending purchasers because of its simple neat and effective performance and sensibly designed output circuitry.



Graph of total difference frequency distortion. Percentage distortion versus peak-to-peak amplitude.

MEASURED PERFORMANCE OF : HERTZ LINEAR 6.2 AMPLIFIER

SERIAL NO: M 696

(INPUT UNBALANCED)
FREQUENCY RESPONSE (-3dB re 1 watt):

		Filter		Flat
Input to Aux = 0.5V	Left(B)	25 Hz	to	120 kHz
	Right(A)	25 Hz	to	120 kHz

Turnover Frequencies		Filter In		
	Left(B)	61 Hz	to	120 kHz
	Right(A)	61 Hz	to	120 kHz

SENSITIVITY (for 1 watt in 8 Ohms):

	Left(B)	Right(A)
Auxiliary	92 mV	93 mV

INPUT IMPEDANCE (@ 1kHz):

	Left(B)	Right(A)
Auxiliary	15 k ohms	15 k ohms

OUTPUT IMPEDANCE (@ 1kHz): 69 milliohms

HARMONIC DISTORTION:

AT A POWER OF 10 WATTS INTO 8.0 OHMS

	100Hz	1kHz	6.3kHz	
2nd	-89.6	-70.9	-55.7	dB
3rd	-96.0	-74.7	-60.0	dB
4th	-101.0	-81.6	-67.0	dB
5th	-104.5	-104.4	-	dB
T.H.D.	0.0038	0.035	0.20	%

AT A POWER OF 10 WATTS INTO 4 OHMS

	100Hz	1kHz	6.3kHz	
2nd	-85.1	-67.2	-51.1	dB
3rd	-85.8	-64.6	-50.0	dB
4th	-96.3	-75.9	-60.7	dB
5th	-98.3	-79.8	-	dB
T.H.D.	0.0078	0.073	0.43	%

AT RATED POWER OF 320 WATTS INTO 4 OHMS

	100Hz	1kHz	6.3kHz	
2nd	-80.5	-65.1	-50.1	dB
3rd	-74.6	-69.8	-54.3	dB
4th	-102.5	-75.9	-60.2	dB
5th	-86.0	-67.2	-	dB
T.H.D.	0.021	0.079	0.38	%

AT RATED POWER OF 320 WATTS INTO 8 OHMS

	100Hz	1kHz	6.3kHz	
2nd	-83.1	-67.5	-51.7	dB
3rd	-78.7	-80.9	-58.9	dB
4th	-107.6	-103.7	-66.2	dB
5th	-91.6	-71.1	--	dB
T.H.D.	0.014	0.052	0.29	%

IEC HIGH FREQUENCY TOTAL DIFFERENCE FREQUENCY DISTORTION

8 kHz and 11.95kHz mixed 1.1

At rated power	0.12 %
At 10 watt	0.07 %

MAXIMUM OUTPUT POWER AT CLIPPING POINT (IHF-A-202):

		8 ohms	4 ohms
(20 mS burst repeated at 500 mS intervals)		155 V p-p	150 V p-p
	=	375 watts	703 watts
∴ Dynamic Headroom (re 320 watts)	=	0.7 dB	1.3 dB

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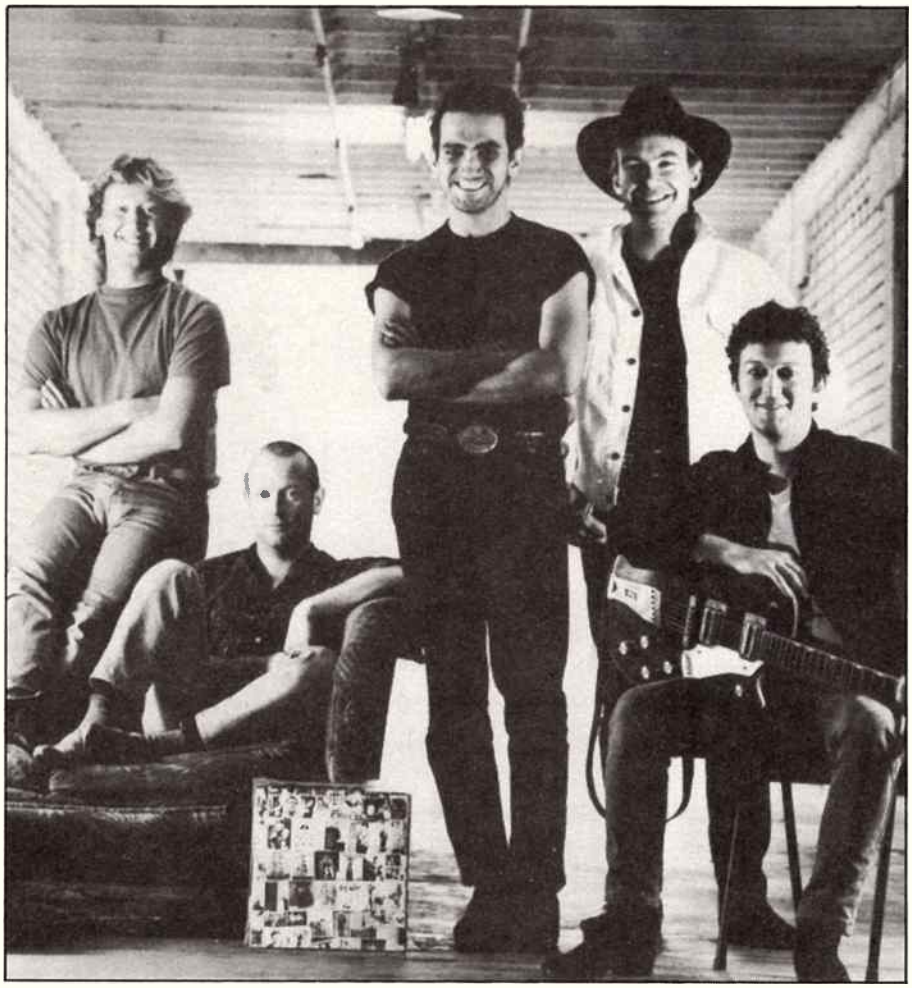
COMPACT DISCS



Artist — Paul Kelly and the Coloured Girls
Title — Under The Sun
Producers — Paul Kelly And Alan Thorne
Label — Mushroom
Cat — CD 53248

Paul Kelly is possibly Australia's foremost fringe artist. Certainly an occasional single has charted but mainstream success is yet to come his way. It is doubtful that UTS will remedy this, which does not detract from the fact it is a very credible offering.

Kelly's wry, and often witty, lyrical observations, combined with some diverse musical influences, make this album a positive joy in comparison to much of the angst ridden, overproduced, pop music available today.

The better tracks are: *Dumb Things,* a pacy pop tune with a self deprecating lyric; *Same Old Walk,* a brisk rock song with a great guitar hookline; *Big Heart,* a bouncy pop tune with tasteful steel guitar and a catchy chorus; *To Her Door,* a straightforward rock song again with good guitar and an interesting slice of life lyric; *Bradman,* a tribute to the cricketer that on the surface appears hokey, but in fact works well.

Paul Kelly and his 'Girls' have a heavy touring commitment both here and overseas and deserve to break the cult mould to gain a wider audience. They have the talent and the heart, let's hope they have the luck.

Recommended.

— *Mark Lewis*

Artist — Joe Cocker
Title — Unchain My Heart
Producers — Charlie Midnight and Dan Hartman
Label — Capital/Liberation
Cat — CDLIB 5128

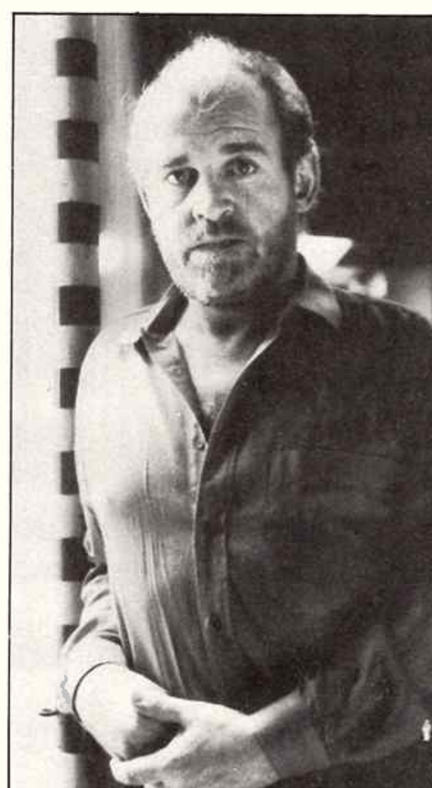
Joe Cocker has produced what is possibly the finest album of his long and sometimes checkered career. With a backing band that is tighter than the proverbial fish's rear end, and Cocker in truly great vocal form, this release bristles with electrifying intensity.

The better tracks are: *Unchain My Heart,* a superb, brassy, big production treatment of this Ray Charles classic; *Two Wrongs,* a punchy R&B number with great guitar, a strong beat and Cocker singing up a storm; *Isolation,* a moving rendition of this difficult John Lennon song; *Satisfied,* an upbeat, full on rock tune, with some fine guitar and tight background vocals.

This release is a must for any lover of R&B. Cocker, like fine wine, continues to mature and if this album is any indication we should be hearing a lot more from him.

Recommended.

— *Mark Lewis*



Artist — Yes
Title — Big Generator
Producers — Yes, Trevor Horn, Trevor Rabin, Paul De Villiers

Yes have always been one of, if not the most, aristocratic of contemporary rock bands that flourished in the early to mid-seventies. Combining excellent music and musicianship with interesting, although somewhat nebulous lyrics, they have endured where many have folded.

Big Generator is consistent with this and, apart from some inspired guitar playing from new addition Trevor Rabin, will hold few surprises for Yes followers.

The better tracks are *Rhythm Of Love,* a lush powerful pop rock arrangement with fine keyboard and guitar soloing; *Big Generator*, a raunchy big beat number with biting metallic guitar sounds and instrumentation; *Shoot High Aim Low*, a weaving dreamier piece that again features fine musicianship and excellent vocals. Indeed all tracks on this CD are classic examples of musicians well versed in production and musical techniques.

With *Big Generator*, Yes continue a tradition of offering the discerning rock fan quality thought-provoking music. Their halcyon days are possibly over but this release is nonetheless a delight.

Recommended.

— Mark Lewis

VIDEOS

Title — The Postman Always Rings Twice
Distributor — MBM
Length — 113 mins
Rating — PG
Standard — ****

Would that all old movies were of this ilk. This classic of the crime genre fairly crackles with tension and lust as John Garfield and Lana Turner take centre steps. Despite the passage of the years, the sheer sultriness and perhaps even seaminess of this offering have not diminshed the iota. Lana is suitably scheming and Garfield, surely one of the unrecognised talents of the silver screen is dumb, but menacing at the same time. Cecil Kellaway is perfectly cast as the addled husband who meets a grisly fate at hands of these two fated lovers. This original offering fairly trounces the later film which starred a jaded Jack Nicholson and an equally paltry Jessica Lange.

Peter Brown

Title — Suzi's Story
Distributor — CEL
Rating — G
Standard — ****

For all those who have ever entertained any doubts about the ravages of AIDS, its sheer human tragedy and the emotion of the moment of death and passing, tune into this offering. A warning though: your perception of the world may never be the same again. Suzi, as named in the title, is the wife of former Divinyls manager, Vince Lovegrove. Unknown to the couple, before they married Suzi had already contracted AIDS from a former lover. The graphic quality of this film is that Suzi, knowing she had only a few months to live, still consented to the making of this offering and the results are truly graphic. Before your eyes, a young and beautiful woman wastes away to nothingness, her every movement sheer torture, her every moment could be her last. Scenes with her child are something to bring a tear to the eye of even the most jaundiced. I pride myself somewhat on my cynicism, but the tears certainly rolled down my cheeks throughout this magnificent effort. Should be compulsory viewing.

Peter Brown

Title — Buddy Buddy
Distributor — MGM
Length — 96
Rating — M
Standard — *

What a disappointment this offering turned out to be. You would have though that when the combined talents of Walter Matthau, Jack Lemmon and Billy Wilder got together, hilarity would have to be the result. After all, these are the same gents who bought us *The Front Page* and *The Odd Couple*, but the boys are pretty lame in this tepid piece. Jack plays a potential suicide and Matthau is unconvincingly cast as a Mafia hit man. This blacker than black comedy failed to elicit even a sneer from this side of the tube and I was left wondering why the three gents in questions left their respective talents at home instead of bringing it before the camera. Vastly disappointing, considering the filmic track record of these three. Avoid at all costs.

Peter Brown

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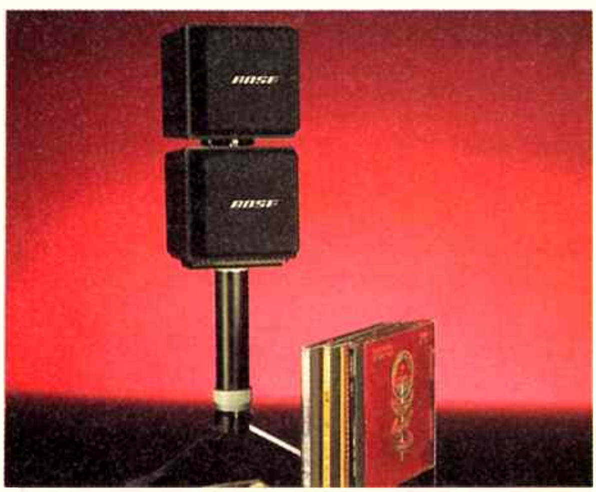

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READER INFO No. 16

```
VZ 300

2 CLS:COLOR2,1
3PRINTTAB(13)"U-FOE"
5INPUT"INSTRUCTIONS (Y/N)":A$:IFA$="Y"THENGOSUB2000
7P=68:H=63:Y=1:L=20:X=63:M=3
10MODE(1):U=0
15GOSUB4000
20FORA=1TO30:SET(RND(127).RND(4)):NEXT
25CLOR3
27FORA=1TO5:SET(H+A.L):NEXT
28COLOR2
30 FORA=1TO10:SET(X+A.Y):NEXT
35COLOR3:Y=Y+1
40 FORA=1TO14:SET(X-2+A.Y):NEXT
45COLOR4:Y=Y+1
50 FORA=1TO24:SEET(X+A-7.Y):NEXT
60 Y=Y+1
70FORA=1TO14:SET(X-2+A.Y):NEXT
75P=68:U=U+1:IFU>4THEN7ELSEIFM=2THENM=3ELSEIFM=3THENM=4ELSEM=2
76COLORM
80FORA=5TO9:IFA>20THENL=32
85IFA>32THENL=44
90I=RND(20):D=RND(2)
100FORJ=1TOI
110IFA>44ANDPOINT(P.A)THENGOTO10
120IFD=1THENP=P-1ELSEP=P+1
122IFP<1THENP=1:D=2:A=A+1:GOTO120
124IFP>126THENP=126:D=D+1:A=A+1:GOTO120
127IFA=LANDP=>HANDP<=H+6THENSOUND25.5:P=68:L=20:H=63:GOTO75
130SET(P.A)
135GOSUB1000:COLORM
140NEXT
145NEXT
150SOUND3.4:3.4:3,4:ST=ST+1:IFST=3THEN5000ELSEL=20:H=63:GOTO75
1000A$=INKEY$:IFA$=""THENRETURN
1005COLORRND(3)+1
1006IFH>121ANDA$=".."THEEN1040
1008IFH<1ANDA$="M"THEN1040
1010IFA$="M"THENSET(H-1.L):RESET(H+5.L):H=H-1
1020IFA$="."THENSET(H+6.L):RESET(H.L):H=H+1
1025COLOR4
1040RETURN
2000CLS:PRINTTAB(13)"U-FOE"
2010PRINT"YOU MUST DEFEND THE CITY AT THE BOTTOM OF THE ";
2020PRINT"SCREEN FROM ALIEN MISSILES WITH YOUR THREE ":
2030PRINT"SUPERSAUCERS(TM). THE CITY CAN WITHSTAND THREE ";
2040PRINT"DIRECT HITS BEFORE IT IS DESTROYED."
2050PRINT"CONTROLS ARE:"
2060PRINT"M-LEFT        .-RIGHT"
2070PRINT"IF YOU MISS THE MISSILE WITH YOUR FIRST SAUCER ";
2080PRINT"ANOTHER WILL APPEAR DIRECTLY UNDER IT AS SOON ":
2090PRINT"AS ONE OF CONTROLS IS PRESSED. THE SAME ";
2100PRINT"WILL HAPPEN WITH THE SECOND BUT NOT THE THIRD."
2110PRINT"PRESS ANY KEY TO PLAY."
2120IFINKEY$=""THEN2120
2130RETURN
4000FORA=40TO80
4010I=RND(ABS((A-39)-20))+44
4020FORJ=63TOISTEP-1
4030SET(A.J)
4040NEXT:NEXT
4045CLOR1
4050FORA=1TO30:SET(RND(18)+48.RND(13)+49):NEXT
4060COLOR2
4070RETURN
5000SOUND5.5:4.5:1.5
5010CLS:PRINTTAB(12)"SCHMUCK!"
5020PRINT"YOU LET THE CITY BE DESTROYED!"
```

U-FOE

Full instructions are included in the text, but the idea is to defend a city at the bottom of the screen with three flying saucers.

L. Alderton
Dunnedoo
NSW

```
0 REM STOP THIEF BY JOHN SYMONDS FOR THE C64
1 GOSUB 5
2 REM
3 SYS 848
4 GOTO 2
5 FOR T=848 TO 881
6 :READ A:POKE T,A
7 NEXT T
8 POKE 788,52
9 DATA 234,76,85,3,96,165,197,201,64,208,249,173,141,2,208,244,165,145
10 DATA201,127,208,8,169,0,133,145,76,84,3,234,76,85,3,0
11 INPUT N$
12 IF N$="JAJSPP88"THEN GOTO 100
13 SYS64738
14 RETURN

READY.
```

Stop thief

This program is a software protection program for the commodore 64 computer. Once run it waits for the password to be typed in. If you type out the wrong password the computer resets itself, so there is no second tries for that hacker that lives in your household.

If you type the right password the computer will go to line 100. So this is where you insert your program.

The password can be changed to whatever you want, simply by changing the password in line 14.

John Symonds
Sandringham
Vic.

```
128 POSTER PRINT

10 REM *************************
20 REM *** 128 POSTER PRINT ***
30 REM ***    BY J.VELLA    ***
40 REM ***     JULY '87     ***
50 REM *************************
60 GRAPHIC1
70 OPEN4,4 C$=CHR$(8) N$=CHR$(15)
80 FORXD=0TO279STEP80 FORYP=0TO199 FORXP=0TO79
90 X=XD+XP Y=YP
100 LOCATEX,Y A=RDOT(2)
110 IFA<>0THEN B$="●"
120 IFA=0THEN B$=" "
130 F$=F$+B$
140 NEXT
150 PRINT#4,N$,F$,C$
160 F$=""
170 NEXT
180 GRAPHIC0 SCNCLR
190 VOL15 PLAY"AAA"
200 PRINT"PLEASE PUT NEW SHEET IN PRINTER"
210 PRINT PRINT PRINT PRINT"PRESS ANY KEY TO CONTINUE"
220 GETZ$ IFZ$=""THEN 220
230 GRAPHIC1
240 NEXT
250 GRAPHIC0 SCNCLR
260 PRINT PRINT"YOUR POSTER IS FINISHED"

READY.
```

128 Poster Print

This program converts any hires screen on a C128 into a poster. The finished poster will be four sheets of foolscap wide by about two sheets in length. To work the program, all that is needed is to have the screen ready with your picture, design or whatever is already there, switch on the printer and run the program. It will tell you everything you need to know, even when to put a new piece of paper in the printer.

Jerry Vella
Tregear
NSW

Letters to the Editor

Great mag
Good! Best value for money yet.

M. May,
Maylands Pastoral Company
Tyalgum NSW

Yearbook
The 1988 Yearbook was very interesting and a valuable reference for the next 12 months.

J. Harvey,
Harvey Instruments
Blacktown NSW

Reviews
Keep up the great reviews. They can save many hours of time being wasted by both sales staff and buyers during listening tests.

John Bass,
Moorooka Qld

Big Bang
Excellent mag. Keep up the good work. More telephone projects: DIMF remote control, digital home PABX, Viatel terminal, CD-ROM converter for an audio CD player, satellite receiver, data encryption. There's lots of things you could do. Nuclear Fusion at home? Think big!

Graham Leadbeater,
Telecom Australia
Ringwood Vic

Ideas, of course, are easy. Turning out real live circuits is a little more difficult. Remember ETI is not a closed club. If you think you have a circuit that's as good as the circuits we publish, and you think it could make a good project, and you want to earn a bit of money on the side, give us a ring on (02) 693-6666 and ask for Jon Fairall or Terry Kee. We've already published an article on nuclear fusion at home. Think bigger!! — Ed.

Professional Audio
Your magazine is very good and worth reading. However, I am mildly disappointed that advancements in the professional audio field, such as the live sound and recording industries, are not being covered in the magazine.

Marcel V. D. Linden,
AVL Repair
Fortitude Valley Qld

Less advertising
Spare us the advertising. Spare us the sore eyes after a long day.

Helen Mezentsef,
Padstow NSW

— Apart from the fact that the ads carry valuable information on price and availability, they also pay for a good proportion of the magazine. We just spent six months agonising over one price hike — we don't want another one just yet! — Ed.

Sound Insights
I really appreciate your new separate hi-fi magazine. I hope you will continue to publish more on quality hi-fi equipment and reviews and continue to support public awareness of good components and systems.

D. Deleon,
Fairfield NSW

FM Broadcasting
How about an article explaining why FM broadcasters are using so much signal processing and compression, effectively dragging the medium down to AM standards. Music is tone in time with dynamics — a fact that is generally being ignored.

C. M. Curtis,
Sound Department
Sydney Opera House
Sydney NSW

Top marks
Yours is a top quality mag. You guys and gals do a great job and I hope it will continue for a very long time.

Terry Cosgrove.

1616 graphics
Great project that 1616. Is there a graphics board somewhere on the horizon?

Guy Winkey,
Cranbrook Qld

As yet we're unsure. Upgrades are in the wind. — Ed.

PALs and GALs
Please publish an article about PALs. The only thing I know about them is their name.

Andrew Bromage,
Mooroolbark Vic

Next month we have an article that looks at all forms of silicon. Order a copy from your newsagent. — Ed.

AIDS
I found the article on the theory of Prof Wickramasinghe (ETI, Oct 87) very interesting. I would like to read more on this subject. Can you help me?

Brian Power,
Crina Qld

Hoyle and Wickramasinghe have written a number of books on their theory of cosmic evolution. They should be available in any good public library. — Ed.

The Yamaha System
A great hi-fi magazine that complements a terrific electronics magazine.

How about a review of the Yamaha 10000 system, amps, preamps, CD, etc.?

Stephen Pascoe
Birkdale
Qld.

Idea of the Month

CW Adaptor
Modern Amateur transceivers are capable of all-mode operation, in contrast to older sets with limited, even single mode capability.

This adaptor was devised as a means of operating semi break-in MCW on an older type 2m FM-only transceiver. It has also been used with success to produce CW operation on a simple SSB only HF unit, and should prove suitable for use with, for example, CB rigs converted for use on the amateur HF bands.

On key down, transistor switch Q1 is turned on, enabling IC1(a) which then oscillates at an audio frequency determined by RV1 and C2. The square wave audio frequency signal produced is filtered (to remove the higher order harmonics) and the output level set by adjustment of

Minimart

For Sale 4164 (64K) dynamic rams. These are used chips removed from old systems so no refunds at this price. 85 cents each plus $3.00 P&P each order, or $80 per 100 including postage. Don McKenzie, 29 Ellesmere Cres., Tullamarine 3043.

FOR SALE: Completed 1616, keyboard, power supply, manuals, etc. Fully socketed. Worth $836 unassembled. Sell $750. Phone (02) 6398262 after 6 pm.

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

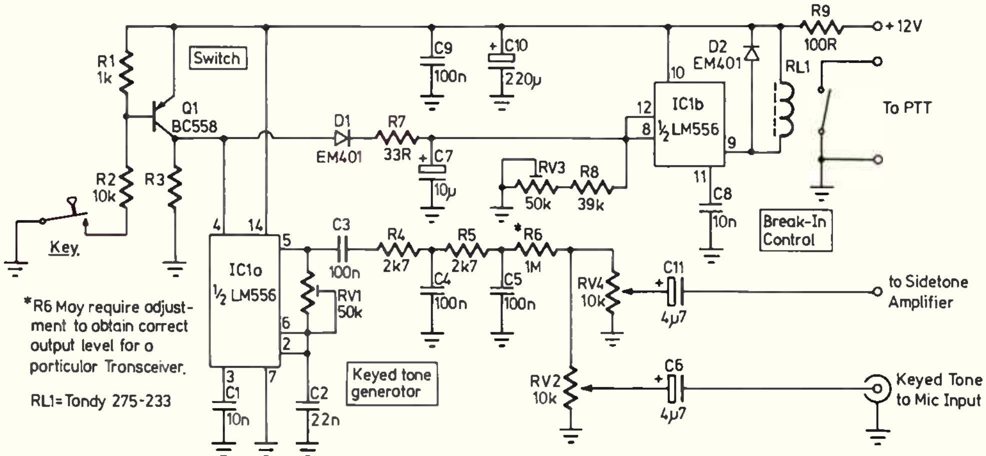
FOR SALE: Completed 1616, keyboard, power supply, manuals, etc. Fully socketed. Worth $836 unassembled. Sell $750. Phone (02) 639 8262 after 6 pm.

RV2. The value of R6 may require some adjustment to set the correct output level to suit individual cases. The output is applied to the microphone input of the rig as a keyed audio tone.

Q1 also provides charging current for C7 via D1 and limiting resistor R7. The low value of R7 permits fast charging of C7.

IC1(b) operates as a simple comparator, energising relay RL1 when C7 voltage reaches 2/3 of the supply voltage. RL1 grounds the rig's PTT line, switching it to "Transmit".

When the key is released, Q1 returns off, and C7 discharges at a rate determined by the setting of RV3. When the C7 voltage falls to below 1/3 of the supply voltage, IC1(b) releases RL1, and the rig switches back to "Receive".



That is, R7 determines the attack delay for Transmit/Receive switching, while RV3 determines the droupout delay.

Sidetone may be produced by feeding keyed tone from RV4 to the receive audio stage or to a separate audio amplifier.

R. J. Martindale
Mill Park 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 your 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.*"

* Breach of copyright is now a criminal offence.

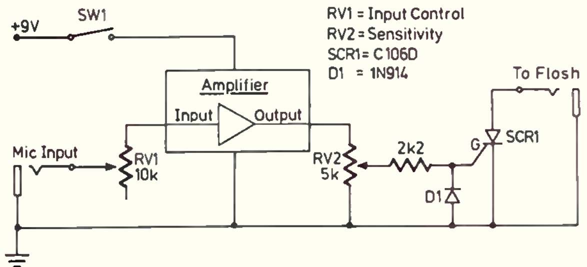
Title of idea/program ....

Signature .... **Date** ....

Name ....

Address ....

.... **Postcode** ....



Sound Activated Electronic Flash

Using a small amplifier, this inexpensive sound switch can take excellent stop-motion photographs. This could be, a coin dropping into a bowl of water, a dart bursting a balloon or anything of that nature, with a scope limited only by your imagination.

The whole unit can fit in any box large enough to hold the amplifier, and can be "hard-wired" or assembled on a tag strip. Construction is simple, just watch the SCR and diode polarities.

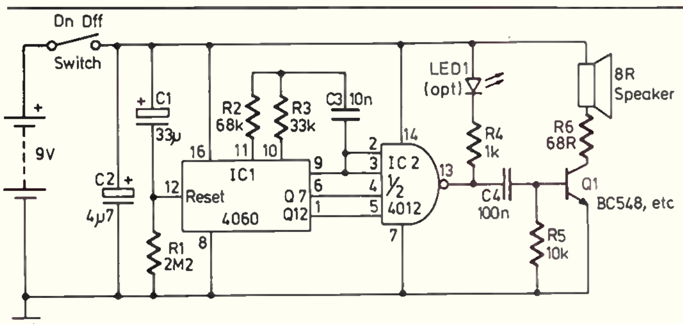
The flash is connected to the unit by an extension "sync" cable, preferably of about a metre in length. Cut off the end that connects to the camera, and connect it to the circuit. As there is no standardisation in the photo industry, I suggest using banana plugs and sockets in case the polarity has to be changed. (This is probably the case if the flash keeps firing without a noise being applied to the microphone.) Another thing to note in construction is to use shielded cable from the mike socket to the amplifier.

To set up the unit to take a photo, first set RV1 to full setting, and the second pot RV2 to about midrange. Then plug in the flash and mike and apply power to both units. The flash may fire once or twice before settling down. If it keeps firing as soon as it recharges, reverse the connections to the circuit.

With the polarity correct, whistle into the mike as you slowly turn RV1. The flash should go off, and from there it is a matter of see-sawing the controls until you get the hang of how sensitive your mike is.

Set the camera and flash up as in the diagram, and I suggest for best results, a film of about 125 ASA is used. Set the aperture as usual for a flash, and set the shutter speed to "B". Turn the flash and switch unit on, and make sure it is all working correctly. In a dark room, and with the lens cap on, open the shutter with a cable release and lock it open. Check the unit once, and when the flash has charged, quietly remove the lens-cap, and get assistance to do the action that makes the sound (e.g. throwing a dart). The flash should go off, and you can close the shutter.

N. Scull
Mt Lawley
WA



"Clayton's" Pocket Pager

Want an excuse for leaving that boring business meeting or just want to impress acquaintances? Try this little gadget.

Sneak the switch to "on". After a time delay a persistent audio signal emits, enabling face saving departure to "ring the office".

The deluxe version also boasts an additional flashing visual signal.

At switch-on, C1/R1 resets IC1 until C1 charges up. Once C1 is charged (takes about 50 seconds with the values indicated), IC1 is able to oscillate at about 1kHz.

The divided-down outputs appearing at Q7 and Q12 of IC1 are gated together with the 1kHz primary oscillator signal in IC2 to produce an output alternately consisting of a quiet period and a series of short 1kHz bursts.

Transistor Q1 amplifies the output of IC2 and drives a small 8 ohm loudspeaker.

The audio signal produced is most persistent and is sure to attract attention.

To complete the illusion, a suitable case is required. I used the case from a defunct Dick Smith "PocketCom" 27MHz transceiver. This is ideal pocket size, and comes complete with an externally accessible battery compartment. There is sufficient interior space to easily accommodate the circuit built on a small piece of stripboard.

R. J. Martindale
Mill Park
Vic.

Appliance Alarm

To turn the ciruit on, one of the mercury switches or micro switches must close to provide a gate current for the SCR.

When a small current flows to the gate terminal, the SCR stays locked on like a normal diode.

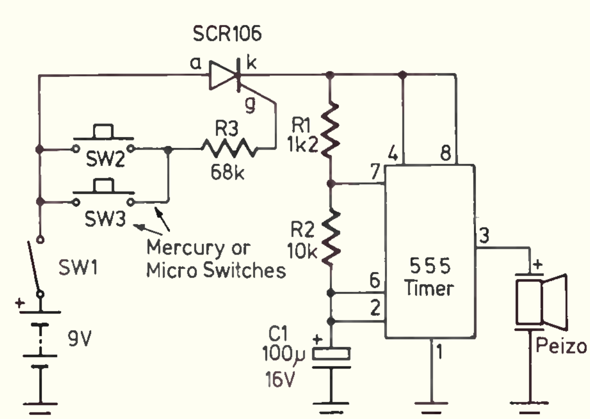
The supply voltage to the 555 astable multivibrator is now connected making it switch on.

It gives a square wave at pin 3 turning the peizo on and off. The rate at which the peizo turns on and off is determined by the values of R1, R2 and C1.

To reset the circuit and turn it off SW1 must be opened.

Graham Lismanis
Bayswater WA

NOTES:
1. 33uF/2M2 combination of R1/C1 gives approximately 50 seconds turn on delay.
2. R2/R3/C3 values shown produces fundamental oscillator frequency of approx. 1 kHz.
3. Use of LED visual indicator is optional if not required, then also delete R4.



Sil-pads

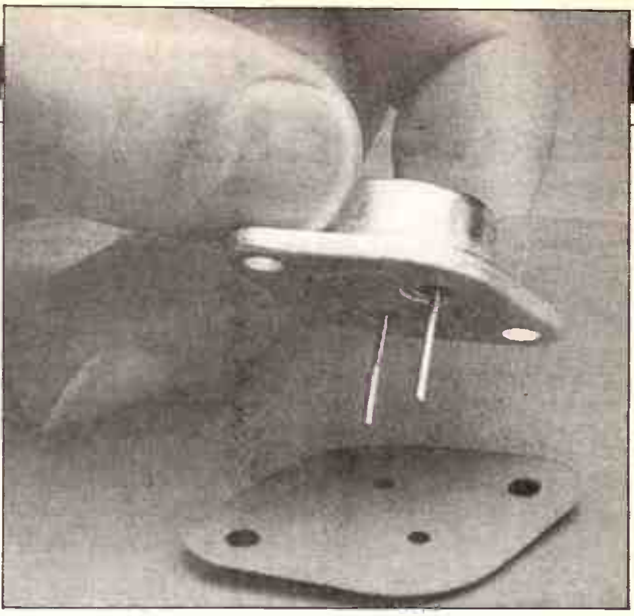
The US Berquist company has released Sil-pads, the latest generation thermally conductive insulators. The material comes in a number of different formats, and will fit most industry-standard shapes like TO-3 cases, as well as squares and rectangles.

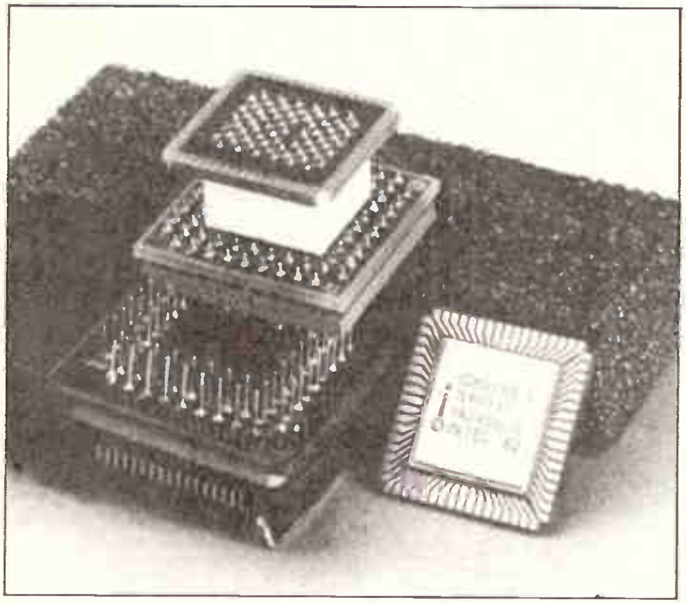
All the Sil-pad products are silicone based products that typically mount between an active device and a heatsink. They are non-toxic, will not support fungal growth, are not damaged by hydrocarbon-based solvents and tolerate soldering type temperatures.

According to Electrotool, which is distributing them in Australia, their biggest selling point is that they do not require any form of greasing to make good thermal contact. All that is required is a pressure between 300-600 psi, typically applied by screwing down a TO-3 case onto a heatsink.

For more information, contact Electrotool on (03) 848-1811.

READER INFO No. 1





Cellular Phone Chip

Motorola has introduced the MHW806A Series of RF power modules for land mobile radio manufacturers who build cellular radios.

The MHW806A is a high gain module with a minimum of six watts output power having controllable, stable performance over more than 35 dB range in output power which is needed for cellular applications.

The MHW806A is an improved version of Motorola's MHW808A which has been the mainstay in early designs of cellular radio. The basic circuit has been redesigned for more cost-effective manufacturing processes and to better reflect industry needs.

Four versions are available featuring different combinations of frequency bandwidth and gain.

For further information contact Motorola on (02) 438-1955.

READER INFO No. 3

Analyser Enhancements

Philips has extended its high-specification PM 3570 family of logic analysers with the introduction of a number of options to meet specific application requirements. These include a new software disassembler for the Intel 80286 microprocessor, and an updated release of the Motorola 68020 disassembler.

The 80286 disassembler has type number PM 8858/70, and comprises the disassembler software on a plug-in disassembler board for the PM 3570 logic analyser.

The new 68020 disassembler Release 2.0 comprises the disassembler board and a personality adaptor with pin-grid device mounting. Specific enhancements of this new release include state-line reshuffling, which displays disassembled instructions in logical mnemonic order, and a program monitor that gives a constant indication of the synchronization process at the top of the screen. Also included is an additional, simpler, 68020 disassembler which maximises the number of instructions shown on a single display. The 68020 disassembler package has type number PM 8858/30.

For more information contact Philips on (02) 925-3333.

READER INFO No. 2

Fast E^2 PROM

Integrated Device Technology (IDT) has announced its entry into the CMOS 16K EEPROM market with the introduction of two products, the IDT76C16 and IDT78C18. These provide two features that are different from traditional EEPROMs: a 55 nanosecond (ns) read access time and a serial capability called the Serial Protocol Channel (SPC).

With a 55ns access time, IDT's new EEPROMs are claimed to be more than twice as fast as existing NMOS 16K EEPROMs. In the past, the fastest access times ranged from 150-200 ns and the fast segment of the market was largely ignored. The new devices mimic the speeds found in static RAMs, using a CEMOS process to provide the speed and low power."

SPC is the first serial access scheme for EEPROMs. It allows rewrites to occur serially, via the SPC pin set, eliminating on-board microprocessor interaction in control store reloading operations.

The IDT78C16 and IDT78C18 also feature internal address/data input latches that free up the microprocessor systems for other tasks during a write cycle. An internal charge-pump allows 5 V only operation and internal timers provide self-timed write cycles. Writing is easily performed because IDT's EEPROMs write like a static RAM, and DATA bar polling is used to determine completion of a write cycle.

For further information contact the George Brown Group on (03) 329-7500.

READER INFO No. 4

Telephone Protection

ABE Computers has developed a telephone safety device which will protect a telephone user or connected equipment such as computers and modems from lightning strikes.

The Telephone Safety Device (TSD) plugs directly into the Telecom wall plug and acts automatically the instant any greater voltages than that required to carry the telephone signal is detected.

The Managing Director of ABE Computers, Mr Max Elliott, had initially developed the device to protect the company's public bulletin board computer system, which was permanently connected to the phone lines.

"Human beings are just as delicate as computers where hazardous electrical voltages are concerned so we have decided to make it available for general telephone use," he said. ABE Computers is also a national manufacturer and distributor of a range of modems, devices used to enable computers to connect and communicate by telephone.

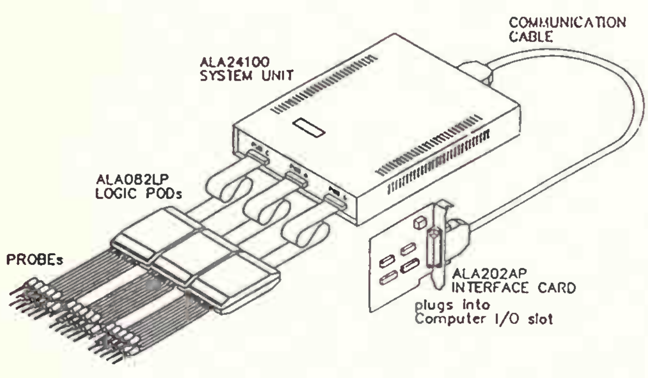
"The TSD can also be used to protect Telex, Facsimile and answering machines. When plugged into the wall socket, and correctly earthed, it provided total security against lightning strikes and any other stray voltage charge that may enter the lines," Mr Elliott said.

ABE has taken out international patents for the TSD and hopes to interest international distributors in the product.

It is presently available only from ABE Computers for $29.50 including tax.

For further information contact: Mr Max Elliott, ABE Computers, 24 Burwood Highway, Burwood, Vic 3125. Telephone: (03) 288-2144.

READER INFO No. 5



PC-based Logic Analyser

Emona Instruments has released the Axelen ALA24100, an adaptor that converts any IBM-PC/XT/AT or compatible into a high performance, 24-channel, 100 MHz, logic analyser. Not only is the system extremely user-friendly, but it also offers a cost advantage that makes it much more accessible compared to equivalent stand-alone instruments.

All that is required with the ALA24100 is a PC with one floppy disk drive, 256KB memory and any graphics display card.

In normal operation there are four basic modes: FORMAT to set up all parameters; TIMING for display and analysis of timing diagrams; LIST for display and analysis of state diagrams (BIN, HEX, ASCII, OCT); DOS, to manipulate data files and add/edit comments for future reference.

For more information contact Emona on (02) 519-3933.

READER INFO No. 6

Light Converters

Tektronix is introducing a pair of optical/electrical converters that permit analysis of light signals on its 11000 Series oscilloscopes.

The P6701 and P6702 converters enable the CROs to act as high-frequency optical oscilloscopes by combining the functions of optical power meters with extensive waveform acquisition, display and analysis capabilities.

With the 11400 digitising and 11300 analogue oscilloscopes, these converters act as calibrated optical waveform analysis tools. Users can analyse mixed analogue and digital, electrical and optical signals simultaneously.

Both the P6701 with a bandwidth of dc to 700 MHz and the P6702 with a bandwidth of dc to 500 MHz can be used for high speed analogue optical waveform analysis. Together, the converters offer a waveform response ranging from 450 nm to 1700 nm, making them useful for research and development projects involving from near ultraviolet to near infrared light. These waveform response capabilities enable the converters to cover the 850 nm, 1300 nm and 1550 nm fibre optic communications bands. Waveform response is 450 nm to 1050 nm on the P6701 and 1000 nm to 1700 nm on the P6702.

Tektronix has made the P6701 and P6702 converters the size of typical scope probe compensation boxes that easily fit into the palm of your hand. Like probes, they mount directly onto the front panels of the 11000 Series oscilloscopes rather than taking up bench space.

For further information contact Tektronix on (02) 888-7066.

READER INFO No. 7

ASIC + CPU

NCR Microelectronics has added an 8-bit core microprocessor (MPU) to its two-micron CMOS cell-based application-specific integrated circuit (ASIC) library. It combines the Motorola 6805 MPU with configurable memory and logic functions to implement a system-on-a-chip.

Developed as part of NCR's technology exchange with Motorola, NCR's 68C05 core MPU contains the arithmetic logic unit and executes the entire 6805 instruction set. It can be integrated with NCR's VS2000 (2μ) library supercells, including digital logic cells, analogue cells and large user-configurable functional blocks. The latter include RAM, dual port RAM, ROM, shift registers, ALU multiplier/accumulator, counters and PLA, all of which can be parameterised to suit a wide variety of microprocessor-based system applications.

For users who wish to integrate a PC board system containing the standard 6805 part into a single chip, the translation from the standard part to the VLSI core is straightforward due to identical 8 MHz external and 4 MHz internal bus frequencies and an identical instruction set.

NCR is presently designing the 68C05 core into the first customer devices. The non-recurring engineering charge for an ASIC device containing the core depends on the size of the device and the complexity of the surrounding logic. Prototype lead-time, including layout, design verification and test program generation, requires two to four weeks beyond the typical 10 to 12 weeks, depending on the complexity of the chip and the number of gates.

For more information call Energy Control International on (07) 376-2955 and Wellington (NZ) 64-4-858742.

READER INFO No. 8

Microwave Attenuator

The UK-based microwave engineers Flann Microwave, have released a Rotary Attenuator that provides high accuracy and direct reading attenuation measurement from 0 to 60 dB within the waveguide bands covering 1.14 to 170 GHz.

The absolute maximum attenuation which these instruments achieve is considerably in excess of the calibration range limit of 60 dB. The additional attenuation permits scale alignment well beyond the basic range requirement and it is this factor which principally contributes to the enhanced accuracy specification of 0.1 dB or 1% of scale reading whichever is the greater. The SWR for most models in the series is less than 1.15.

For further information contact Flan Microwave Instruments in the UK on (0011) 44-208-3161.

READER INFO No. 9

Octal DAC

Analog Devices in the US has released the AD7228 monolithic integrated circuit, with eight fully independent 8-bit DACs, bus interface circuitry, and voltage-output amplifiers in a single low-power, small package.

The system microprocessor writes an output value to any one of the eight built-in DAC latches as an address in memory; the required 95 ns write pulse is directly compatible with most bus speeds. The output amplifier of each DAC can provide up to +10 V into a 2 kΩ load. A single supply of +12 to +15 V or dual supplies (+12 to +15 V and −4.5 to −5.5 V) can be used for improved performance; power consumption is typically less than 240 mW/310 mW (for single/dual supply) as a direct result of the linear compatible CMOS (LC^{2}MOS) process. Relative inaccuracy of ±1/2-LSB and total unadjusted error of ±1LSB maximum ensure that this octal DAC requires no associated calibration or trim components, and reduces the total installed cost.

For more information contact parameters on (02) 888-8777.

READER INFO No. 10

More Moto Mem

Motorola's Memory Products Division is adding two new 1-megabit CMOS DRAM devices to their memory line-up. The one meg is configured as 1,048,576 bits or 262,144 four-bit words.

In addition to the standard operating DRAM mode, three other modes of operation are also available for high speed access. These include the page mode, the nibble mode, and the popular static column mode.

These advances have been made possible as a result of more sophisticated circuit design and fine line processing techniques.

Following the trend of industry standardisation, the devices are initially to be housed in a 300 mil wide plastic dual-in-line package.

READER INFO No. 11

Datacraft X.32 Support

The recent release by Telecom of its X.32 standard created a niche market for Australian telecommunications companies which has been exploited by Datacraft.

The modem makes lost no time developing and manufacturing a packetlink modem which allows utilisation of the new X.32 service. It will allow an X.25 packet mode host or terminal to connect to a packet mode device via the switched telephone network.

The beauty of the X.32 service is that it will allow data to be passed error-free from the equipment on the customers premises through to the Telecom Austpac connection.

For further information contact Datacraft on (02) 438-2955.

READER INFO No. 12

Voice Encryption

EA Technologies has released the GSA1300A, a medium-level voice security device designed for operation over two-way radio networks. Application of this device within a radio system is claimed to almost eliminate the possibility of an eavesdropper listening and understanding your radio communications.

The module employs CMOS surface-mounted devices that operate in the time domain. Full digital processing of the audio signals ensures excellent decrypted speech. Because the GSA1300A uses the standard audio bandwidth, the radio's performance will not be degraded. In fact, if a clear transmission can be heard, then the voice privacy device will operate normally.

The ciphering process consists of an analogue-to-digital conversion of incoming audio. The resultant data is stored in RAM. Each digital segment is then scrambled according to GSA Technology's ciphering software. The data is converted back to an analogue waveform and fed to the parent radio.

For more information contact GSA on (03) 379-1828.

READER INFO No. 13

Optical Attenuator

Intelco has released its model 210, claiming it is ideal for multimode optical margin measurements and fibre loss simulations in the field, factory or laboratory. Optimised for multimode applications, the 210 uses anti-reflective coatings, expanded beam technology, and precision parts to hold a ±0.5 dB calibration accuracy over a 10 to 40 dB range. Calibrations are user-selectable between 850 and 1300 nanometres. Attenuation can be varied continuously from the insertion loss to over 50 dB. The insertion loss is under 2.5 dB.

A 0.1 dB direct reading, digital liquid crystal display on the 210 eliminates the guesswork and readability problems associated with graduated dials. Even the insertion loss is accounted for in the displayed readings.

An internal lithium battery powers the 210 for over 10 years under typical use.

For more information contact Scientific Devices on (03) 579 3622.

READER INFO No. 14

STD Bus Single-board PC

Ziatech Corporation has extended its line of PC POS equipped STD bus systems with the introduction of STD DOS V20, a highly integrated PC-compatible, industrial control system. The new single board computer is based on the NEC V20 with versions that run at both 5 and 8 MHz providing performance that exceeds the IBM-XT personal computer.

Two memory configurations give the user either 256K bytes of RAM with 256K bytes of PROM capacity, or 384K bytes of RAM with 128K bytes of PROM capacity. An additional 8K bytes static RAM contains a system configuration file that can be edited by the user. Battery backup of the on-board RAM is available as an option.

The V20 single board computer can be connected to other STD DOS systems and IBM-compatible PCs through Z-net, a complete Ziatech network solution based on the ARCNET protocol and Western Digital ViaNet software. To complete the industrial DOS system EGA video graphics, floppy and hard disk and a new bubble memory are all available.

For further information contact Current Solutions on (03) 720-3298.

READER INFO No. 15

New from ETP

ETP Oxford has released two new products of interest.

The LeCroy Model 9100-Arbitrary function generator (AFC) is capable of generating standard or custom waveforms. High-speed custom waveforms are available in a dual output signal source. Standard waveforms, such as sine, square, triangle, ramp, pulse and dc are also included.

The AFG can generate square waves or pulses up to 100 MHz and sine waves up to 25 MHz. Its dual output can be summed internally to provide large dynamic range and provides unique waveform control in that the amplitude of one portion of waveform may be controlled independently of the rest of it.

The generator's large fast memory (64K points) may, through the capability to link and repeat waveform segments, be extended to the equivalent of billions of points. Once waveforms are loaded into the AFG's non-volatile storage memory (350K point RAM disk) the generator no longer needs a computer and can be controlled with the optional control panel.

Meanwhile, ETP Oxford is also distributing Thorn EMI's new 9223, 9224 and 9226 metal ceramic photomultipliers.

These tubes can be supplied for operation up to 2000 C. They utilise a high temperature bi-alkali photocathode covering the range 270 nm to 500 nm with quantum efficiency of about 17% at 300 nm. The metal ceramic construction offers superior resistance to damage from shock and vibration. Each tube contains an integral voltage divider.

The tubes are 12-to-14 stage multipliers and typically require around 2000 volts to achieve a gain of 10^6. They are available in three nominal diameters, viz: 26.4 mm, 32.4 mm, 32.4 mm and 50.8mm. Connection to the voltage divider is made through captive wires.

For further information contact ETP Oxford on (02) 858-5122.

READER INFO No. 16

Quest CAD

Quest International Computers has released the latest pc board CAD system from Personal CAD Systems.

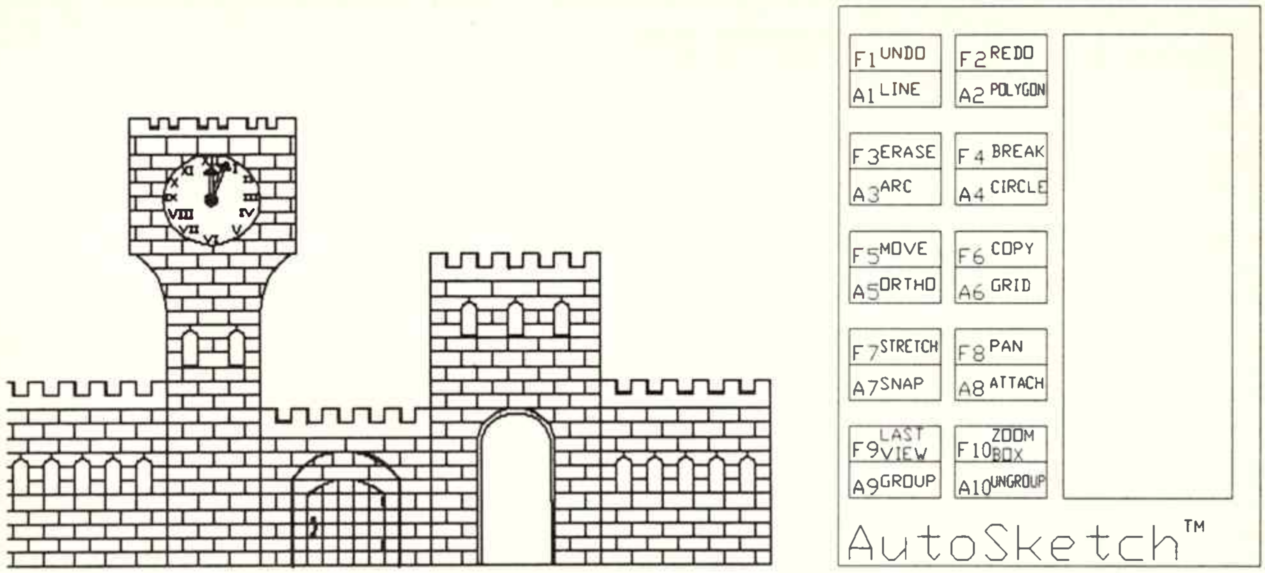
The new Master Designer CAD/CAE Design System is claimed to handle pc board designs two to three times as large and up to twice as fast as PCAD's popular PCB-3 design package, with which it is compatible.

"CAE/CAD designers can now get performance and functionality rivaling that of a high-end workstation on their PC-based system without giving up the familiar, easy-to-use PCAD interface" said Greg Fidock, Principal Design Engineer with QUEST.

Large design databases can be accommodated to support up to 1300 components, 32,000 pins and 2500 nets, and engineering changes can now be easily incorporated with forward annotation of logic changes, and "history — independent" back annotation.

For more information contact Quest Computers on (03) 277-7444.

READER INFO No. 17



Products of AutoSketch. Left the plots were obtained on an Epson printer in graphics mode. At right are the commands assigned to the 10 function keys on the keyboard, plotted on an AST laster printer emulating an HP7475.

AUTOSKETCH

US company, Autodesk, has released a stripped down version of their world beating AutoCAD package. Will it also beat the best?

Kevin Barnes

Some years ago a group of people in the USA got together to form a company to write and market software. The application they chose was Computer Aided Drafting (CAD), the company they called Autodesk and the product they called AutoCAD. The rest is history.

Autodesk was not content to rest on its laurels, however. Over the years it has progressively improved AutoCAD, keeping it at the front of the high performance microcomputer CAD market. Unfortunately, what has also happened is that the price of AutoCAD has escalated, and a number of much lower-priced CAD packages have appeared in the market place, offering excellent performance. In response, Autodesk has released a program called AutoSketch, a scaled-down version of AutoCAD.

AutoSketch is a general purpose, object oriented drafting program. Being object oriented means it remembers a line as two points joined together, and not as a string of dots as they appear on the computer screen. Being general purpose means there is virtually no limit to the kinds of drawings you can prepare with it, for example, architectural plans, work-flow charts, graphs, pcb artwork, circuit diagrams and maps. Thus, AutoSketch is quite different from many of the specific drafting packages that are now available to things like pcb layout and schematic capture. While AutoSketch will do these kinds of drawings it is by no means as efficient or productive as these specialized programs.

To use AutoSketch the user manipulates some form of pointing device (usually a mouse) to build a model or database of the drawing in the computer's RAM. This model is then used to construct a pixel image which is viewed on the computer screen to show what the drawing will look like, or the drawing can be stored in the computer's disk for a permanent record. When the drawing is finished AutoSketch will control some peripheral device (usually open plotter or graphics printer) to produce a hard copy of the scaled drawing.

AutoSketch is very different from pixel oriented drawing programs which have major limitations and restrictions. Being object oriented and with a resolution of seven significant figures means you can zoom in for an extremely close-up view of part of the drawing or out for a complete view. For example with seven significant figures you can draw a map of Australia to give to mother-in-law so she can find her way to your house, and include on that map a scaled outline of the plan of your house to an accuracy of about one millimetre.

To make or edit a drawing, the user controls AutoSketch by either typing commands from the keyboard (eg, VIEW, ZOOM) or by pointing at entries in the menu, or by pointing at an object currently drawn in the screen. The pointing is done with the cursor, its position being controlled by the movement of a mouse over the table top. Many people find pointing with a mouse a much easier way to select an object or command because you don't have to know where all the keys are on the keyboard.

At the top of the screen you see displayed the menu bar with the names of seven menus. Each of these menus have from five to 12 commands listed in them.

Pointing at the menu causes that menu to roll down the screen revealing all the names of the commands it contains. You then move the mouse to select the one particular command you want. One advantage of the menu system is that displaying command names jogs the user's memory as to available commands.

At the bottom of the computer screen is the prompt line. During a drawing session, text is displayed there to remind the user what information AutoSketch expects to be supplied in order for it to complete the selected operation. Keys typed from the keyboard are also echoed there.

The commands in the menus are detailed in Table 1. This will give the experienced CAD user some idea of the features of AutoSketch. Note that the DRAW menu is really a list of objects, eg. lines, circles, text, etc. These objects are the building blocks from which the user constructs their drawing. The VIEW menu has the commands that let you change your view of the drawing on the computer screen without affecting the contents of the drawing. You can ZOOM in close and PAN around looking at different objects or you can ZOOM back for a full view of all the drawing.

The ASSIST menu contains toggles for several AutoSketch drawing aids. These aids are there to overcome the imprecision of drawing with a mouse and viewing with a coarse display screen. ORTHO forces lines to be drawn only vertically or horizontally, GRID and SNAP make all your spacings the same and your lines join up. The CHANGE menu lets you MOVE, COPY or basically modify existing objects in various ways. To select an object to be operated on you point to it or open a little window around it. The window method is handy when you want to select several objects at one. The MEASURE menu has commands that let you measure various aspects of your drawing. These measurements are either displayed on the screen in dialogue boxes while others are included as part of your drawing. The FILE menu has commands to let you begin new drawings, load old drawings, save the current drawing for later or to plot a drawing.

Equipment Requirements

AutoSketch is designed to run on a 8088/80286/80386-based computer running PC-DOS or MS-DOS (version 2.0 or higher) and equipped with a graphics screen (note the higher the resolution the better). The setup menu list contained entries for CGA, EGA and Hercules display cards. This evaluation copy would only work with a computer fitted with a maths coprocessor chip, but this was stated on the outside of the blister pack and I understand that there are other versions of AutoSketch that do not need the coprocessor.

To use AutoSketch effectively you will also need two other items, a pointing device and a graphics output device. For pointing devices the setup menu has entries for only these four: a Microsoft Mouse, a Koala Pad, a Joystick or an ADI pointer. You can use the arrow keys on the keyboard, but I found this a very tedious method and used a mouse instead. My mouse was a genuine Microsoft one and I didn't have any trouble using it. I did try to use a Logitech mouse but could not get it to work. If you have one of these strange mouses that emulate the Microsoft mouse you should be OK, but it would be best to check it out first. I was a bit disappointed that the better quality bit-pad digitisers were not supported. While rather expensive they do make the entry of existing drawings much easier.

An essential item to allow you to get the most out of AutoSketch is a device for making hard or permanent copies of your drawings. For high quality hard copies you probably need a plotter; AutoSketch supports the Hewlett-Packard and Houston range. My plotting was done on a AST laser printer which was runing the HP7475 HPGL emulation. I was able to get AutoSketch to talk directly to the laser printer and also send the output file to disk. I later spooled it to the printer with the PRINT command. Where quality is not that important and money is, AutoSketch will printer plot your drawing on a graphics printer. For a list of the types of printers supported see Table 2.

Nice things to say . . .

AutoSketch also has a number of features normally only found in advanced packages. Whenever it asks for points, you can type them in as X,Y coordinates, you can point with the mouse or you can enter them relative to the last point as X and Y offsets or as polar coordinates with a distance and an angle. Another nice feature is that some commands can be activated by pressing one of the function keys. Another is semi-automatic dimensioning. To add a dimension to your drawing all you have to do is point to the start and the end of something, then point to where you want the text to be printed and AutoSketch does the rest. It calculates the length, draws in the arrows, and prints in the text. In AutoSketch the distance between two points is measured in units. A unit can correspond to whatever form of measurement your drawing requires. It can be inches, feet, centimetres, angstroms or whatever, the only time you have to worry about scaling is when it comes time to plot and make your hardcopy.

Under the CHANGE menu are a number of very useful commands that will speed up your drawing and editing, like COPY or MIRROR for example. These will let you edit your drawing to correct mistakes or bring an old drawing up to date quickly and without having to do it again from scratch. The GROUP command is very useful. By grouping several objects together you form one object which you can work on as a single entity, eg. MOVE it, without having to select the same individual objects again and again. The command STRETCH is useful for changing existing objects. With STRETCH you move only selected points that make up the object. For example you can move the position of a door or window in a floor plan, or the drawing of a flip flop on your circuit without having to ERASE it and redraw it.

. . . and not so nice things

AutoSketch supports LAYERS. When you draw on object it exists only on the

TABLE 1. THE ROLL DOWN MENUS

Draw	Change	View	Assist	Setting	Measure
Arc	Undo	Zoom X	Ortho	Attach	Distance
Box	Redo	Zoom box	Frame	Colour	Angle
Circle	Erase	Zoom limit	Grid	Curve	Area
Curve	Group	Zoom full	Snap	Grid	Point
Line	Ungroup	Pan	Attach	Layer	Bearing
Part	Move	Redraw		Limits	Align dimension
Point	Copy			Line type	Horiz dimension
Polygon	Stretch			Part base	Vert dimension
Text	Property			Pick	Show properties
	Rotate			Property	
	Scale			Snap	
	Mirror			Text	
	File				
	New				
	Open				
	Save				
	Make DXF				
	Pen info				
	Plot area				
	Plot name				
	Plot				
	Information				
	Game				
	Quit				

current layer. The concept is similar to transparent overlays used in many drafting applications. It allows you to draw, view and plot related aspects of your drawing separately or in any combination. For example a pcb board layout would use one layer for the component overlay, another for the solder mask, another for the tracks, etc. To produce the final artwork you then plot out each layer separately. Layers are a very powerful feature but unfortunately in AutoSketch you have only 10 layers which many potential users will find too restrictive.

An important feature of CAD packages is the library and how it is managed. A good drawing technique is to save new objects or shapes on disk for inclusion into future drawings. The aim being, not to have to redraw them the next time they are needed, but to be able to recover them for the library. With AutoSketch you can do this but in a fairly primitive way.

Features missing from AutoSketch that would have been very handy are FILL, SKETCH and CROSSHATCH commands. Crosshatch is very useful when showing cross-sections, and since AutoSketch supports colour, the use of colour and FILL would have given drawings an extra bit of sparkle. I think also some form of freehand sketch feature would have made AutoSketch attractive to those potential users who would prefer more artistic types of drawings. (Although the CURVE command with its spine fit can be a fair substitute for a freehand command.)

The big disappointments of AutoSketch are the TEXT command and the method used to store the drawing in RAM. As supplied, AutoSketch supported only one font. To make matters worse, the style of that font gives you rather strange shapes once the characters become larger than about three millimetres. The other limitation in AutoSketch is the complexity a drawing can reach before it runs out of memory. AutoSketch maintains your drawing in RAM, so when you run out of spare RAM, drawings must stop. To help you manage this limitation there is a memory usage meter in the top left of the screen with a percentage readout.

Documentation

The copy of AutoSketch provided came in a plastic blister pack and contained two 5¼- inch 360K diskettes. One diskette has the AutoSketch program, the other diskette contained a number of sample drawings. Also included in the plastic blister pack was an instruction manual. It has about the same dimensions and printing quality as a paperback but with only 56 pages. I found it easy to read and it seems to cover all the AutoSketch commands, as well as provide some explanations for some of the more tricky concepts used in the program. The explanations were clear and unambiguous but strangely the quality of the paper the manual was printed on seemed to degrade the quality of the information printed on it.

One of the problems with computer programs that are used for non-trivial applications is that quite often the implications of the effect of a command are not immediately obvious to the user on a first read. Take for example the AutoSketch command SNAP which forces all the selected points (eg. a line's beginning and end point) to lie on a rectangular grid. What use is that you might ask? Well it overcomes one of the limitations of the computer screen, with its imprecise alignment of pixels to a point on the drawing. By leaving a SNAP on, you can be sure that when you draw a closed object like a square, the point you started the square on is the one you finish on. In this regard the manual does not cope, but, in fairness and considering the complexity of AutoSketch, a manual deep enough to fully exploit the program would probably cost more than the software.

Conclusion

AutoSketch has a bit of a dual personality. Many of its features are quite powerful and very useful, but unfortunately it has a couple of significant limitations. If you want to do drawings for around the house or if you want to get the feel of what it's like to use a CAD package but don't want to spend a lot of money, then AutoSketch can turn out useful drawings and give you hours of fun. But if time is money and productivity is important then AutoSketch is false economy. The exception here would be if you weren't sure if CAD was for you and you wanted to try it without making a huge investment. A way to test the water without diving in so to speak.

Perhaps you are an AutoCAD user at work and would like to have it at home, but only have a twin floppy computer? Well AutoSketch will work on two floppies. Perhaps then, this is what AutoSketch is all about: an introduction to AutoCAD. And perhaps Autodesk is hoping that AutoSketch will get you hooked on CAD, so you will go out and buy AutoCAD. Drawings from AutoSketch can be read by AutoCAD (Version 2.5 or later) so you can protect your investment if you do go up-market.

This evaluation was carried out on an AT-compatible running at 8 MHz fitted with an IBM EGA screen. ●

TABLE 2. AUTOSKETCH INITIALISING MENU

Used the first time you run AutoSketch to set up the program for your hardware configuration.

Select pointing device:

1. Autodesk Device Interface Pointer
2. Microsoft Mouse
3. Joystick/Koala pad
4. Keyboard cursor keys

Pointer selection:

Pointer selection: 2

Select display device:

1. Hercules Graphics Card
2. IBM Colour Graphics Adaptor (monochrome mode)
3. IBM Enhanced Graphics Display

Display selection: 3

Select plotter:

1. No plotter
2. Epson Printer
3. Hewlett-Packard LaserJet
4. Hewlett-Packard Plotter
5. Houston Instrument Plotter
6. IBM Proprinter XL
7. Okidata Printer
8. PostScript Laser Printer
9. TI 800 Omni Printer

Plotter selection:

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20MHz

GOS-522

READER INFO No. 61

40MHz

GOS-543

READER INFO No. 62

Why buy just a basic 20MHz or 40MHz oscilloscope when you can treat yourself to a fully featured Vertical Mode Triggering oscilloscope with Auto Trigger Level Lock and Variable Hold-Off.

These extra features are normally not found on low cost oscilloscopes, but GW can offer them at a truly unbeatable price. How do they do it? Probably because GW are the leaders in cost effective CRO technology.

The GOS-522, for example, is a true 20MHz bandwidth CRO with a calibrated 20ns/DIV range (unlike CROs offering ranges calibrated to only 100ns/DIV where timing measurements become very difficult). Also, the Vertical Mode Triggering found on both the GOS-522 and the GOS-543 is especially designed for service applications. This allows you to simultaneously compare test points between good and bad boards.

Other features that make these CROs unique in their class include: Auto Trigger Level Lock ensuring perfect triggering without the need to readjust the trigger level when making measurements; Variable Hold-Off which is ideal for stable viewing of digital and video waveforms; fast 20ns/DIV sweep speed offering high precision; DC trigger coupling for low frequency signals and Auto, Normal and Single Shot sweep modes.

Features	GOS-522	GOS-543
Bandwidth	20MHz	40MHz
Channels	2	2
Vertical Sensitivity	1mV/DIV	1mV/DIV
Max Sweep Speed	20ns/DIV	20ns/DIV
Delayed Sweep	NO	YES
Trigger Modes	CH1, CH2, VERT MODE, LINE, EXTERNAL	
Variable Hold-Off	YES	YES
Delay Line	NO	YES
Accel. Voltage	2.2kV	12kV
Warranty	1 YEAR WARRANTY ON PARTS AND LABOUR	
Probes	2 QUALITY SWITCHABLE PROBES INCLUDED	
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READER INFO No. 70

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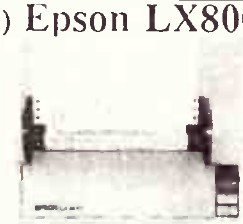
PRINTERS

13) Epson LX800



Our top-selling parallel dot matrix printer. 180 cps, two NLQ fonts, graphics, friction & tractor, single sheet feeder, 12 mths wty. Normally $675. Hurry. Limited stock Our price:

Hurry! Not many left!

READER INFO No. 75 **$497**

14) Panasonic 1081 Printer

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READER INFO No. 76

MODEMS

15) GPA Super-Modem

READER INFO No. 77

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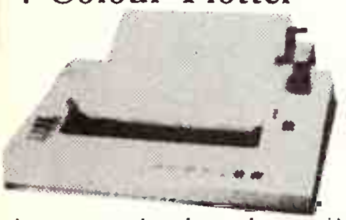
ACCESSORIES

19) COMX PL80 4 Colour Plotter



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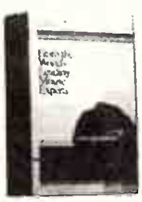
21) Logimouse



READER INFO No. 83

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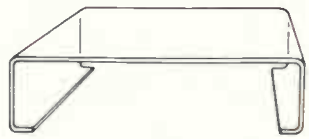
READER INFO No. 84

ACCESSORIES

23) Printer Stand



READER INFO No. 85

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READER INFO No. 88

Apple Bits

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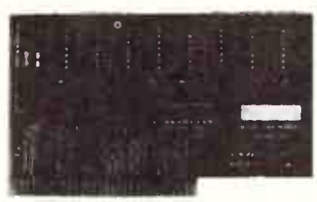

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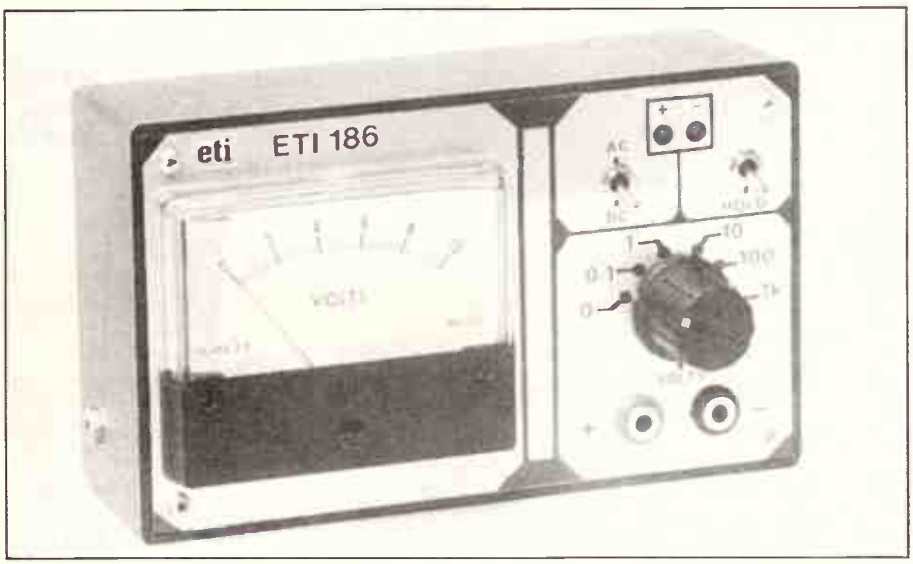
READER INFO No. 57

ETI — 186 WIDE RANGE VOLTMETER

Part 2



Now you know how it works and what it does, we present full construction details of the wide-range voltmeter described last month. Also, we describe how the bar graph meter previously presented can be used as the readout. Add this one to the line-up of instruments described in the series, and have a complete setup that will enable you to operate without a CRO. Well, for most of the time, anyway.

Peter Phillips

IN LAST MONTH'S issue, a description of the circuit of our wide range voltmeter and its development were presented. Now it's construction time, folks. You will need the previous article, as it includes the circuit diagram as well.

Construction

Prepare the front panel first by applying the Scotchcal label to the lid of the jiffy box. As ever, if a Scotchcal label is used, lacquer it before application to the lid. A lid, made of thicker aluminium than that provided with a jiffy box was used in the prototype to give a more solid construction, as the large (50mm) hole required for the meter movement tends to reduce the strength of the supplied lid. However, this is optional. Alignment of the label to the lid can be achieved by indenting the label at the centre of the points used to attach the lid to the box, then, with the backing sheet removed, and the label face down, by lowering the lid carefully onto the label, positioned so that the indents are central to the holes in the lid. Once attached, and excess material removed, the lid can then be drilled according to the panel design. A 9mm drill is required for the sockets and the selector switch, and a 6.5mm hole for the switches. The LEDs can be 3mm types, or the more sophisticated pinpoint types available (orange and green only I'm told) from George Brown. Be careful the drill swarf doesn't scratch the label during drilling. Finally, fit a 3.5mm phono socket to one end of the box, to connect to the external plug pack.

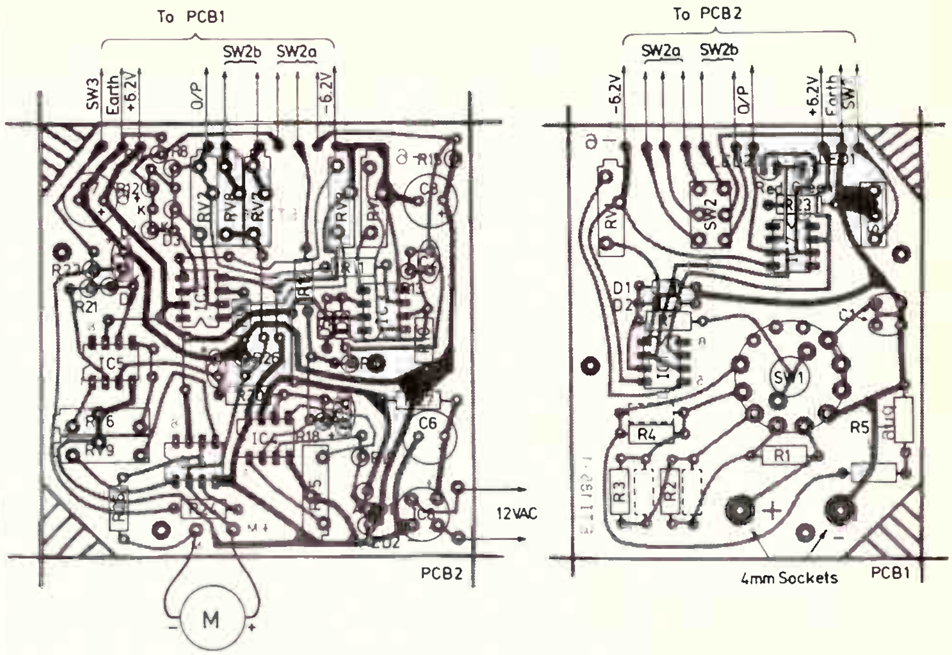
The circuit fits on 2 pc boards held apart by 8mm spacers. The spacers used in the prototype were miniature pc board supports availble from Hi-Com Unitronics at Caringbah, and are ideal for the purpose. The first board (No. 1) contains all the switches, the input voltage divider and ICs 1 and 7, with their components. This board is complete in itself, in that it produces a buffered output of the voltage produced by the potential divider, as well as a polarity indication. It can be tested separately, providing the appropriate dc supply voltages are connected to it. The second board holds the remainder of the circuit, and is connected to the first with 10 connections, all arranged along the top of the boards. The boards are designed to have the track sides facing inwards, to allow access to the components when assembled.

Start with the first board, by selecting the resistors for the potential divider. The ratio of these is important, rather than their absolute value, and an accurate ohmmeter is needed for best results. Select R1 to be as close to 4.7M as possible, then select R2 to be a value one-tenth of R1.

Similarly select R3 to be one-tenth of R2, and R4 a value one-tenth of R3. R5 + R6 needs to be one-ninth of R4, and space is provided to allow two resistors in series to give the required value, (522 ohms assuming R1 was exactly 4.7M ohm). Also, space is provided for parallel resistors to give the correct values for R2, R3 and R4 if necessary. Fit these resistors, and all the remaining passive components, then connect the ICs (socketed if you wish).

Fitting the switches requires suitable sized holes in the board. The range selector switch is the type sold by Dick Smith, and requires 2mm holes in the board. This will completely remove the solder lands for those connections not used, but will leave enough copper for the remainder. Insert the switch fully, then solder it ensuring that good connections are achieved. The toggle switches are pcb, vertical mount types, and should also be fully inserted in the board. If you intend to test this board, attach the LEDs temporarily, as they are best fitted when final assembly to the front panel is undertaken. The 4mm input sockets are connected to the board with short leads, and then only after the front panel is fitted.

Next, mount the components on the second board. There are eight wire links, and these should be fitted first, using insulated telephone wire. The layout is fairly crowded, and some components are mounted vertically. Mount the ICs and the pots last. Note particularly the suggested mounting orientation of each vertically mounted component, arranged to minimise the possibility of bare leads shorting together. It is important to use components no higher than 20mm on board 2, as otherwise the whole assembly won't fit in the box. The 470µF capacitors should be



selected accordingly, and will need to be 16V types (or less) for this reason.

The meter movement used is the Manipa, style MU52E, available from Jaycar. Two types are available; a 1mA version, and a 5A version. The design calls for, obviously, the 1mA meter, but, faced with a shortage of these, I resorted to the 5A type, with the shunt removed. However, the meter movement in this case is a 5mA type, and requires two component value changes if used; R25 from 1k to 470 ohm, and R26 from 120 to 10 ohm.

With all components in place, examine the boards for possible shorts between tracks, and double check the orientation of all the diodes. Finally, attach the interconnecting leads between the boards, using 25mm lengths of multistrand wire. These wires all connect to the track side of both boards, and should be laid so that the wire can fold inside the gap between the two boards. Attach wires to connect the meter movement and the phono socket, and temporarily connect leads to act as an input connection.

Set the range switch to the 0V position, and apply power to the circuit. Assuming the meter movement doesn't deflect violently in either direction, confirm that the supply rails are around 6.2V with respect to ground by checking the voltages present at pin 4 (negative) and pin 7 (positive) of any of the ICs. At this point, the meter may be deflecting, due to the dc offsets of the amplifiers. If excessive deflection is occurring, measure the outputs of each of the op amps, (pin 6), working back from IC6. The fault will be around that point associated with the op amp with an output exceeding 200mV, and located furthest from IC6. A likely fault is a stand of wire from the interconnecting leads shorting to an adjacent point on the board. If all is well, select either the 100mV or 1V range, and hold the positive input wire. This should cause the meter to deflect upscale, proving the circuit is responding to an input. Also, both LEDs should light, indicating an ac input. If so, proceed to calibrate the instrument, otherwise find the fault by measuring the outputs of the op amps when an input is first applied, then removed. Note that the circuit is very sensitive, and will respond to an adjacent appliance that has a transformer; an effect that is reduced when the front panel is fitted.

Using a bar graph display as the readout

Some readers may like to incorporate the bar graph meter presented in ETI December 1987 and February 1988, rather than a moving coil meter movement. Several arrangements are possible, but the simplest assumes the bar graph meter is a complete unit, powered internally by its own batteries. In this case, construct the meter of this article as described, but insert a 1k resistor in place of the meter movement, and provide two 4mm sockets connected as output terminals across this resistor. Set the bar graph meter to its 1 volt scale, and plug it into the added sockets, (observing the correct polarity), then adjust RV7 and RV8 to give the required full scale deflections for the DC and AC settings. This arrangement means the bar graph meter can be used independently, and plugged into the expansion module represented by the meter of this article as required.

The alternate way of integrating the two into a single unit has not been researched, as it was felt this would increase the overall complexity to an unwarranted extent. Those with a sense of adventure may like to attempt this, but difficulties could arise when deciding how to power both circuits from the available power supply. Certainly, however, using the bar graph meter as the display will give a higher resolution than a meter movement, as well as providing a most interesting and useful voltmeter.

Calibration

Calibration of the instrument is accomplished in 3 stages; zeroing, dc, then ac calibration. A reference voltmeter (ac and dc) and a suitable audio oscillator are required. Commence by setting the zero pots, after the circuit has had power applied for a few minutes. Zeroing is accomplished by setting the range selector to 0V, then by measuring the output (pin 6) of each op amp with a dc voltmeter on its millivolts scale, and adjusting the ossociated offset control. Start with IC1, and try to obtain exactly 0V at its output. The next two adjustments will be impossible to set to zero, as both ICs 2 and 3 are in open loop until feedback is obtained via the diodes. Try to achieve the minimum possible output, which should in any case be within 100mV of zero. Then zero IC4, followed by IC5. This latter IC will have similar characteristics to ICs 2 and 3, but a value within 3mV of zero should be possible. Finally, zero the output of IC6. This should now result in the meter pointer having zero deflection. If not, confirm that the mechanical zero of the meter is correct. Recheck the zeros again, trimming where necessary. These adjustments are important, but are relatively stable.

Now set the meter to its 100mV dc range, and apply a 100mV input voltage of the correct polarity; ie positive to the positive input terminal. Adjust RV7 to give full scale deflection of the meter, then confirm that a 1V input will give the same deflection on the 1V range, 10V on the 10V range, etc. Determine the linearity of the circuit by applying 5V (for the 10V position) and observing a deflection of half scale. Non-linearities may be present in the meter movement, and a compromise setting of RV7 may be required to give the best overall linearity, which should be within ±2%. Finally, reverse the input polarity, and adjust RV2 to give the same deflection as that obtained with the correct polarity. Note that the indicator LEDs should display the polarity of the input. Go over the calibration a couple of times to compromise for any non-linearities. Also, adjust the values of the multiplier resistors R1 to R6 if required to correct scaling errors.

Once the dc conditions are established, proceed with the ac calibration. Apply a 100mV rms, 50Hz input, and set the meter to read 100mV ac, then adjust RV8 to give full scale deflection. Again, it may be necessary to fiddle this setting for the best overall linearity. Confirm that the frequency response is within −1db when the input is 50mV over a range of 50Hz to 200kHz. The output indication may dip at around 160kHz to 45mV, then rise after 200kHz is exceeded. Note that a change of 5mV is still within 1dB. The value of C2 determines the circuit characteristics over 100kHz, and the specified value of 220pF was established after much experimenting. However, component tolerance may require a variation in its value for optimum performance. The frequency response should, at worst, be within ±1db to 200kHz.

The next step requires a small amount of frequency compensation to be applied to the circuit. When the range is set higher than the 100mV range, the 4.7M ohm resistor is in series with the input voltage and IC1, resulting in the stray capacitance of the selector switch and subsequent circuitry becoming significant. For example, a capacitance value of 1pF at 100kHz represents an impedance of 1.6M ohms. Compensation for this is achieved with a short length of wire. A 25mm length of insulated telephone wire soldered to the land for the selector switch that is adjacent to the track connecting the positive input terminal to the selector switch. The correct position of this wire is one that gives the same indication at 100kHz as for 10kHz, assuming a constant input of around 1V, (meter set to read on its 1V scale). Once positioned, a dab of glue should be applied to fix the wire permanently. Finally, confirm that the frequency response of the meter is correct on its 10V scale. If not, change the value of C1; a capacitor that cancels the internal capacitance of the selector switch. Note that space is provided for two, parallel capacitors to give the specified value of 695pF.

Once calibration is correct, the meter can be assembled. Note that it is important to ground the front panel to the negative input terminal to minimise stray pick up. This can be accomplished with a wire connected to a lug under one of the meter movement support bolts. The two LEDs can now be finally fitted and the two boards joined with standoffs.

Using the meter

The meter is simple to use, and the input protection should minimise the effects of overload. A possible limitation is that the meter will read ac on its 'DC' range, and dc on its AC range. The readings will not be correct, in that an ac value shown on the DC setting will be around 40% of its correct value, and a dc value on the AC range will be around twice its correct value. However, this can also be useful, by showing a value that reflects the presence of both types of voltages. A series capacitor can be externally connected to remove a dc component, but elimination of an ac component would require it to be bypassed within the circuit. It was decided not to incorporate any further switching to remove these effects, as, apart from the added complexity, cost and physical size, a possible useful feature would also be removed.

ETI-186 PARTS LIST

Resistors .... all ¼ watt 1% metal film unless otherwise specified. all values in ohms
R1 .... 4.7M (see text)
R2 .... 470k (see text)
R3 .... 47k (see text)
R4 .... 4k7 (see text)
R5 + R6 .... 522 (see text)
R7, R11, R16
R17, R20, R21 .... 10k
R8 .... 4k7
R8, R14 .... 1k
R10 .... 22k
R12, R19 .... 2k2
R13 .... 5k6
R15, R24 100
R18 .... 3k3
R22 220
R23 .... 3.9 ohm
R25 470
R26 120
R27 .... 100 ½ watt

Potentiometers .... all 10 turn trim pots
RV1, RV5, RV6,
RV9 .... 50k
RV2, RV3, RV4 .... 10k
RV7, RV8 .... 100 ohm

Capacitors .... all pcb mount
C1 .... 695pF (680pF in parallel with 15pF)
C2 .... 220pF
C3, C4 .... 4.7µF, 10V tantalum
C5 .... 33µF, 10V tantalum
C6, C7, C8 .... 470µF, 16V

Semiconductors
D1 to D7 .... 1N914 or similar
IC1 to IC7 .... µA771
IC8 .... WO4 bridge rectifier
LED1 .... Pinpoint or 3mm red LED
LED2 .... Pinpoint or 3mm green LED
(pinpoint LEDs available George Brown)

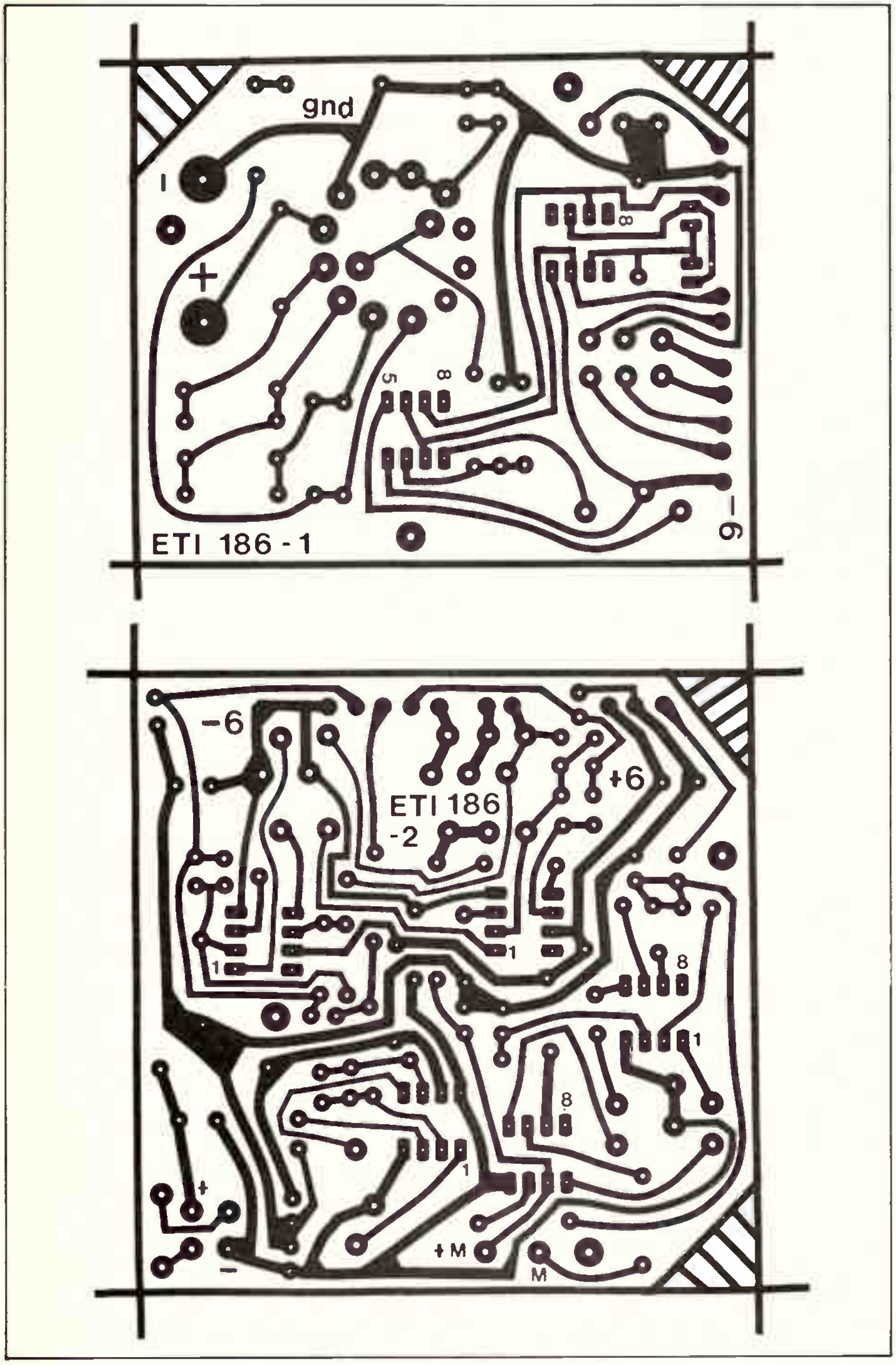
Switches
S1 .... 2 pole, 6 position, wafter switch
(available Dick Smith, cat. no. S-6306)
S1 .... DPDT, vertical mount miniature toggle
S3 .... SPDT, vertical mount miniature toggle

Miscellaneous
PC board; Scotchcal front panel; Zippy box, (50 x 90 x 150 mm); 2 x 4mm sockets; 1 control knob; 12V ac, 300mA plug pack; 3.5mm phono socket; 1mA meter movement, style MU52E (Jaycar); 3 x 8mm spacers.

Specifications
Range selection: 100mV, 1VI 10V, 100V, 1kV fsc. (ac and dc).
Frequency response: ±1db — dc to 200kHz.
Accuracy: ±2% (dependent on meter movement linearity)
Input resistance: 5.2M ohm (dc)

Another characteristic concerns the sensitivity of the meter. The use of a shielded lead is recommended, to prevent stray pick up masking the input. Sometimes it is useful to lower the impedance by placing a resistor across the input terminals, assuming this doesn't load the circuit under test. This is typical of any high sensitivity meter, and is not a limitation.

The HOLD function of the meter is accomplished by charging a capacitor with no discharge path. To use it, select HOLD, connect, then remove the probes at the point under measurement. Because this function also serves as a peak follower, it can be used to follow a voltage variation to determine the highest point. Likewise, if removal of the probes gives rise to a transient, such as exposure to stray pick up, the stored value will be higher than the actual voltage. Experiment to determine the characteristics of this feature. The stored value will remain within −1db for around 30 seconds, but should ideally be read as soon as possible. ●



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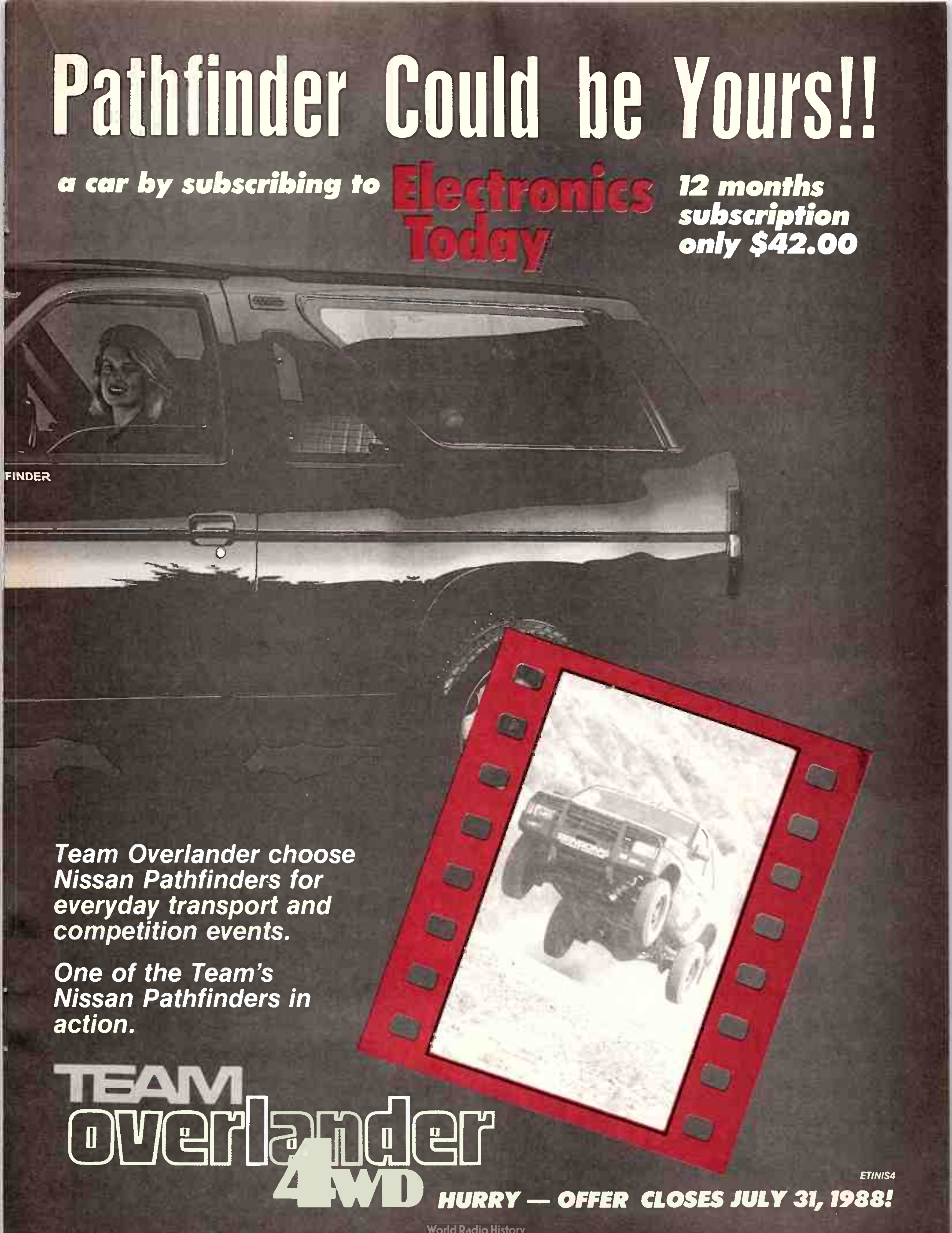
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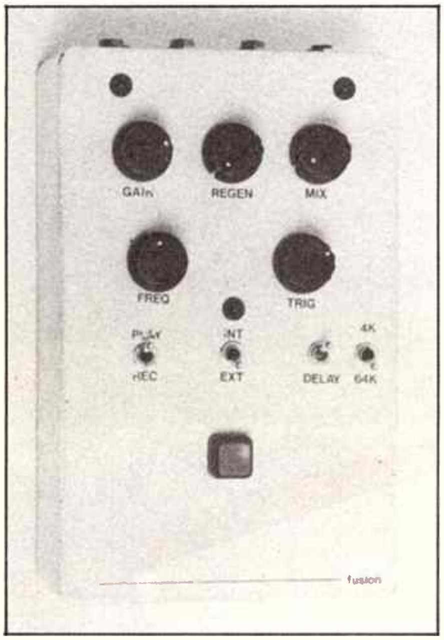
DIGITAL SAMPLER EXPANSION

An upgrade of the ETI-1402 digital sampler that gives you greater bandwidth and sampling time

Andrew Robb/Glen Thurecht



THE ORIGINAL DIGITAL sampler (ETI, June 1986) has proven to be a very popular project. We have received many letters since then, most with a common theme — please give us more memory! So, in this edition, we offer a substantial memory expansion board, as well as a couple of simple, but useful, additions to the original design.

The 4 kHz, 0.5 second performance of the sampler was certainly adequate for experimenting with digital sound sampling and reproduction. However, it has become clear that the sampler could have a definite place in many professional audio set-ups if it had at least an 8 kHz bandwidth. The filter specifications were such that no design improvement was needed, only a different set of resistor and capacitor values to suit the bandwidth desired.

Increasing the memory size offers various alternatives: either a much longer storage time, a wider recording bandwidth, or some of both. Rather than design to a specific option, we are going to leave the choice up to you.

Memory Expansion

Thanks to the ever decreasing size of integration, the latest commercial static RAM ICs offer 16 times more storage than the 'old' 6116 2K RAM, for the same size package, and at a lower cost per byte. We could have kept waiting and designed the expansion around a future, improved, smaller, cheaper IC, but then we would never start. So we decided to design a 64K expansion, based on the 43256 32K static RAM. Keeping the original 4 kHz bandwidth, this will allow a storage time of 8 seconds. Table 1 shows some options now possible.

The 43256 is a high-speed low-power 32,768 word by 8-bit static RAM. It is fabricated using the latest "MIX-MOS" technology. The 43256 is very similar to the earlier 6116, having the same control signals and supply requirements. The only difference is the number of address bits. After considering putting one 43256 in parallel with the 6116s, it became clear that the 6116s might as well not be there in that case. The final design uses two 43256s independent of the 6116s. With 64K of memory, it was also apparent that very short storage times would not be possible. Therefore the new design does not write-off the 6116s, but allows the user to select between using the 64K or the 4K system. An added bonus, not originally planned, was the ability to now store two sounds at once.

The expansion board requires over 30 connections. We did not fancy soldering that many single wires, so the new board has been designed to plug in on top of one of the 6116s in piggyback fashion. This immediately takes care of all of the addressing and data connections, as well as offering some mounting rigidity. The construction is very straight forward, and the result is quite neat.

Other Additions

Although we received some very ambitious suggestions (such as "can you design a microprocessor system to control the clock and make the sampler into a Fairlight?"), two more practical ones were: a POWER-ON LED and a LED to indicate when the system was "armed" and ready for external recording. The power-on LED needs no explanation. The ARMED LED is useful when recording a hard-to-repeat sound, by showing that the sampler is correctly armed.

We also found that the original delay length could be made shorter to achieve better reverberation effects. This is done by lowering the value of the frequency limiting resistor, R44. Again some experi-

Bandwidth Hz	Max Sample Time (sec)	ANTI-ALIASING FILTER R5	R6	R7	C2	C3	Sect Error	R8	R9	R10	C4	C5	Sect Error
4000	8.19												
8000	4.10	27 kΩ	27 kΩ	56 kΩ	2.2 nF	120 pF	0.85 %	22 kΩ	22 kΩ	82 kΩ	1.0 nF	220 pF	0.27 %
12000	2.73	6.8 kΩ	6.8 kΩ	56 kΩ	4.7 nF	100 pF	1.74 %	8.2 kΩ	8.2 kΩ	12 kΩ	2.2 nF	820 pF	0.91 %
16000	2.05	6.8 kΩ	6.8 kΩ	6.8 kΩ	5.6 nF	390 pF	2.0 %	6.8 kΩ	6.8 kΩ	8.2 kΩ	2.2 nF	820 pF	1.66 %

Bandwidth (Hz)	CLOCK REJECT FILTER R15	R16	R17	C9	C10	Sect. Error	R18	R19	R20	C11	C12	Sect. Error	R21	R22	R23	C13	C14	Sect. Error
4000																		
8000	10 kΩ	10 kΩ	39 kΩ	4.7 nF	120 pF	0.03 %	12 kΩ	12 kΩ	56 kΩ	2.2 nF	270 pF	0.85 %	22 kΩ	22 kΩ	82 kΩ	1.0 nF	220 pF	0.27 %
12000	820 kΩ	820 kΩ	1.2 kΩ	82 nF	2.2 pF	0.91 %	560 kΩ	560 kΩ	68 kΩ	4.7 nF	10 pF	1.74 %	820 kΩ	820 kΩ	1.2 kΩ	22 nF	8.2 pF	0.91 %
16000	10 kΩ	10 kΩ	10 kΩ	5.6 nF	100 pF	1.87 %	2.2 kΩ	2.2 kΩ	8.2 kΩ	6.8 nF	820 pF	1.96 %	5.6 kΩ	5.6 kΩ	12 kΩ	2.2 nF	680 pF	1.60 %

Table 1: The component values required in the filter for various combinations of bandwidth and sample time.

mentation may be needed to obtain the optimum value for your chosen bandwidth.

Construction

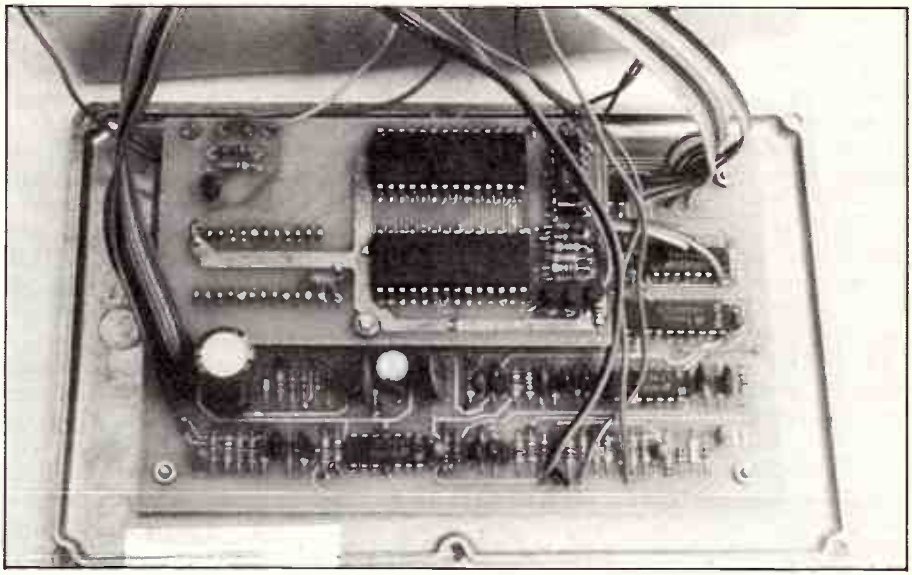
Begin by drilling holes for the two LEDs and the memory-select switch. We placed the POWER-ON LED above the power input socket, and the ARMED LED above the INT/EXT switch. The new switch should fit beside the DELAY switch. Use the new board to mark the two mounting hole positions on the main board. Drill these ready for standoffs. Wire the POWER-ON LED directly to the power socket, with the 560 ohm resistor in series.

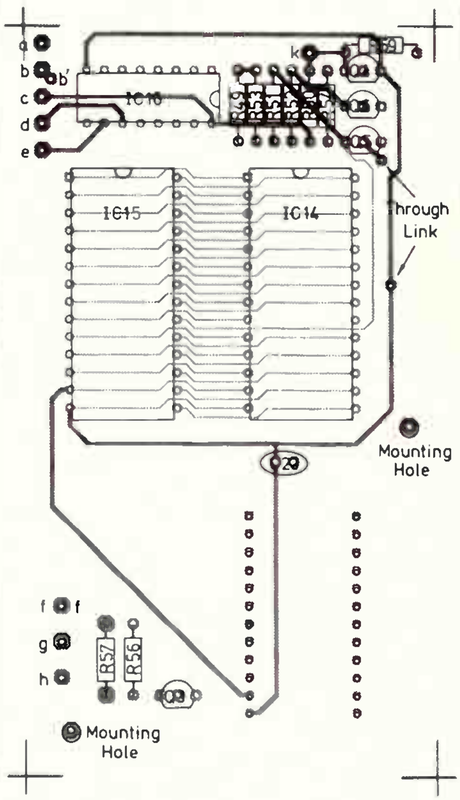
Desolder the old INT/EXT SPDT switch (SW2) and replace it with a DPDT and resolder the original wires to one side of the switch, SW2(a). Wire SW2(b) as shown in the circuit diagram, taking a wire to the centre of PLAY/RECORD SW1(a), and one from +Vcc at SW1(a). Wire the anode (longer leg) of the ARMED LED to +Vcc at SW1(a).

A bit of surgery is needed on the main board, in order to connect the emitters of Q1 and Q2 together. Cut the three tracks as shown in the diagram. The best way to cut tracks on the circuit board is to make two slices across the track about 1 mm apart, with a sharp blade. Then place a hot iron tip on the middle section and slide it away from the board. The result should be a neat gap which can be reconnected if necessary.

Connect the two emitters together using a piece of thin insulated wire. Solder R55 in an upright position from the emitter of Q2 to +Vgg (which runs beside it to R43). Solder a wire from the emitter of Q1 to the lower pole of the new memory-select switch, SW4(a). Similarly, connect IC8, pin 11 on the main board, to the centre of SW4(b). When adding wires like this, you can solder directly to the components, or drill and wire through to underside tracks. Solder lengths of wire to pins 4 (A11), 6 (A11) and 14 (+Vcc) of IC11; to pins 10 (RESET) and 13 (STANDBY) of IC8; from the other poles of SW4(a) and (b); and from the centre of SW2(b).

Now push the 24-pin IC socket over the top of the 6116 IC6 and solder it in this piggybank position. To increase the maximum clock rate, decrease R44 on the main board to 180 ohms.





The new board can now be constructed. Check the pcb for track breaks and shorts before starting. Solder the resistors and through-links first, following the overlay shown. Then add the transistors, capacitor and ICs, soldering on top as needed. Take the usual CMOS precautions and double check the orientation of the ICs before soldering!

Now insert the wire-wrap socket legs about 6 mm through the board and then into the piggyback socket on the main board. Position the expansion board and solder the wire-wrap socket in place. Trim off the body of the wire-wrap socket and solder the top of the board. Finally connect the 10 wires to the new board, following the wiring diagram shown. Note that the two wires go to point "b" on the new board. These are labelled "b" and "b'". The standoffs can now be fitted. A nylon screw will be needed for the standoff in the centre of the main board to prevent shorting of close tracks.

Because of the additional height of the board, we found the battery clip had to be removed. The battery can be placed in one corner of the box and secured with a smaller clip, double-sided tape, etc. Or, as we did, you can just wrap the battery in a thin piece of foam. This keeps it stable, once the whole thing is screwed back together.

Testing and using it

The POWER-ON LED should turn on when you plug the power in. If it doesn't, check the orientation of the LED. Now switch the memory to 64K and try recording something. Depending on your choice

PARTS LIST — SAMPLER EXPANSION (not including replacement filter components)

Resistors

R49,53,54,55,56	10K (0.25W)
R51, 52	47K (0.25W)
R50, 59	1K (0.25W)
R57	470R (0.5W)
R58	560R (1W)

Capacitors

C23	4μ7 16V tant

Semiconductors

IC14, 15	43256
IC16	4040
Q4, 5, 6	BC549
Q3	BC558
D9	red LED
D10	green LED

Miscellaneous

SW2, 4	DPDT switch

24-pin DIL socket, 24-pin wire-wrap socket, pcb, nylon bolts, nuts, standoffs, hook-up wire.

of bandwidth, you should be able to check the duration of the recorded sound at the optimum clock frequency. The correct clock frequency can be found by switching to DELAY mode and reducing the frequency until the clock noise just becomes audible. This frequency setting can be marked on the front panel.

Switch to the 4K memory and verify that it still operates correctly. If you have altered R44, increase the clock rate and test the improved minimum delay.

The ARMED LEG can be checked by switching to RECORD, EXTERNAL and DELAY OFF. The LED should turn on when the arming trigger is pressed, and off when the recording has been completed.

If you have problems, recheck the component layout against the overlay and the wiring. Make sure there are no loose strands touching other pins on the ICs and that the wires go to the correct pins.

As mentioned, you can now store two sounds simultaneously. Of course, if you've increased the bandwidth, the duration of the 4K storage will be decreased from the original 0.5 seconds. However, the 4K memory can still be used for short sound storage. More importantly, having increased the upper frequency limit, the 4K memory can be used to provide a much higher quality reverb effect than the old system.

Because of the long storage times possible with the 64K memory, it is often difficult to tell when a recording is complete. The ARMED LED can be used to indicate this. Using the sampler in EXTERNAL mode, the ARMED LED will remain on until the 64K has been filled.

Modifying the filters

Now with all that lovely memory to work with we have greater flexibility in the sampling time/bandwidth trade-off. The original project had 4K of RAM and a 4 kHz bandwidth was chosen to allow half a second of recording time. With 64K bytes to use, you can select your own bandwidth and sample time.

The decision as to bandwidth requirement really depends on what you can use the sampler for. If you are content with 4 kHz bandwidth, then you don't need to alter the filters. This will give you an 8-second storage time — enough time to record a rabid dog barking and use it as a burglar deterrent! 4 kHz is also adequate for very brassy sounds, such as a bass drum. For storing good quality voice, 12 kHz is probably better. For sounds which have a high frequency dominance, such as synthesisers, glass breaking, etc, 16 kHz is needed. We found that a mid-point of 10 kHz as a reasonable storage time was also desirable.

If you have a particular bandwidth that you wish to implement then both the anti-aliasing and clock reject filters will have to be changed to allow for the different cut-off frequencies. The anti-aliasing filter is centered around operational amplifiers IC(1c) and IC(1b), the clock reject around IC(4c), IC(4b) and IC(4a). We will talk about how to change these filters in a moment. First we can work out the bandwidth sample time trade-off with the equation:

$$\text{Max Sample Time} = \frac{65536}{2 \times \text{BW(Hz)}}$$

A list of common bandwidths versus max sample times is given in Table 1.

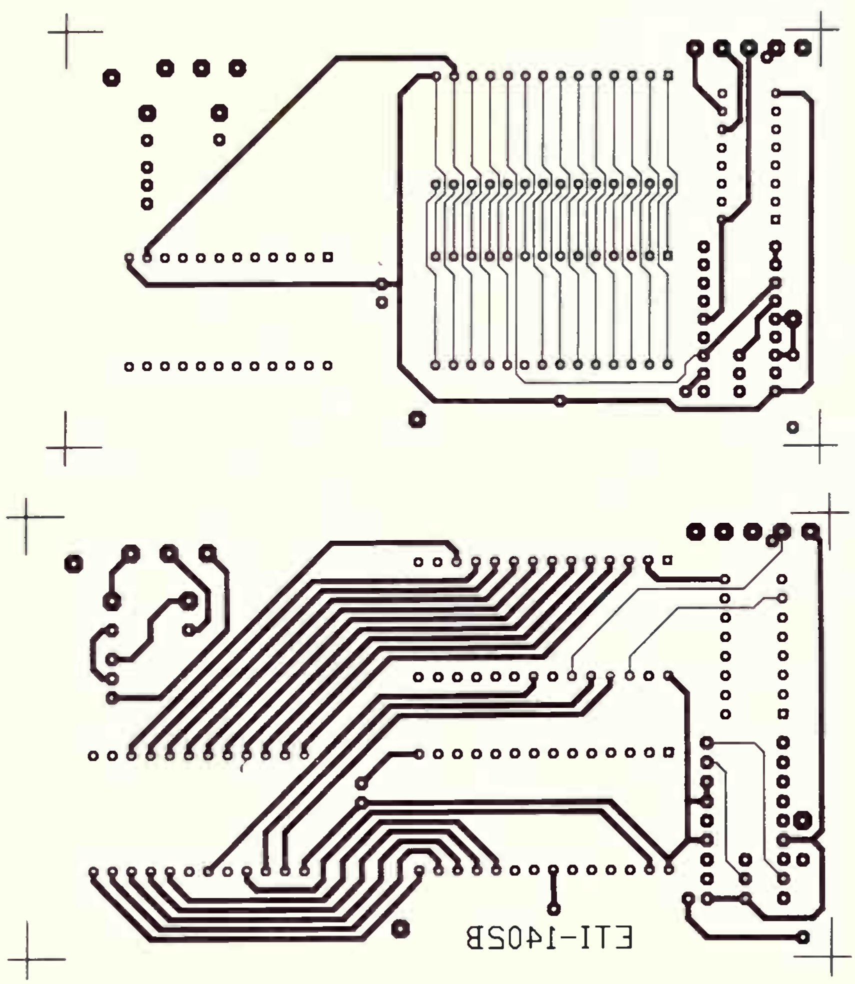
Once a bandwidth has been chosen, the filters may be redesigned with the help of the BASIC program listed. This program first asks for two input parameters:

1. The order of the filter — fourth for the anti-aliasing or sixth for clock reject.
2. The cutoff frequency — which is the bandwidth that you have chosen.

Given these two fundamental parameters we now enter the filter sections caculations. The program then asks for a standard value of C2 (see Figure 1) before calculating the value of the other components in the filter. C2 should be around $10/f_c$ μF where f_c is the cutoff frequency. This then will generate practical values of R1 and R3 (ie, not too small or too big). All components are given as "preferred" values hence there will always be an error between the calculated value and the available value. So, to design an accurate filter the program calculates many different combinations of circuit-preferred values and their associated error compared to calculated values. All you do then is to select the components that have the least error. The error should be below 2%. If it is not, enter a new value for C2 and see if a better combination can be found.

High order filters, as implemented in this project, are made up of cascaded 2nd order stages. Hence for a 4th order filter there are two stages and for a 6th there are three. A single stage is shown in Figure 1. This diagram can then be used in conjunction with the program to design all your filter sections.

Table 1 shows some results of the program and gives the new values for the fil-



HOW IT WORKS

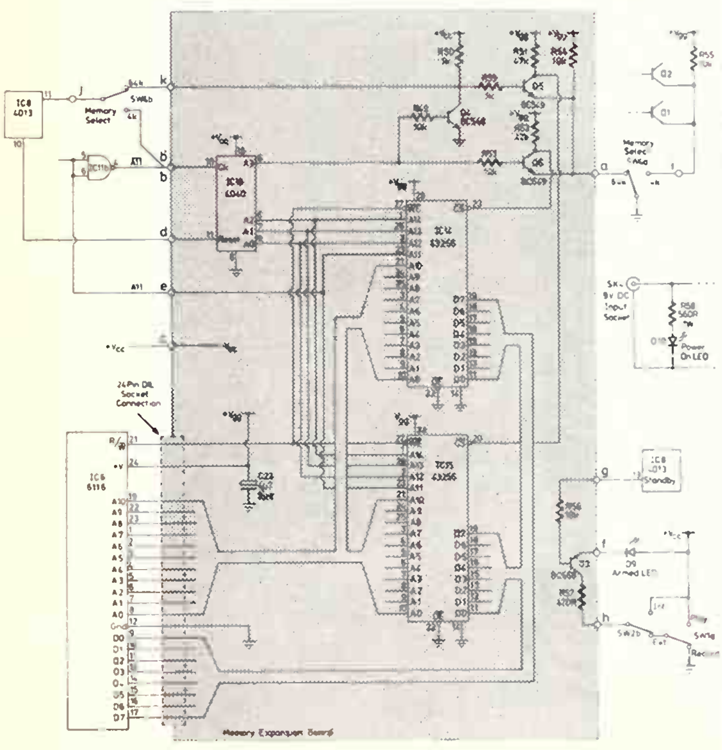
In order to keep continuity with the sampler circuit, the component numbering follows on from the original sequence. The ARMED LED section makes use of the original switching to perform most of the logic selection. The LED should be on when the system is in EXTERNAL, RECORD mode, when STANDBY is low. Transistor Q3 switches on when STANDBY goes low. R57 limits the LED current.

The operation of the expanded memory circuit is basically the same as the first design. 64K of memory requires 16-bit addressing (2^{16}). Each 32K RAM block requires 15 bits, A0 to A14, with the final bit, A15, used to select between memory ICs.

The first 12 address bits are obtained from IC7, the original counter. A second counter, IC16, is used to generate A12 to A15, being clocked by the inverted A11. The second counter is also reset by SYSTEM RESET. The original data bus is wired in parallel to the new memories, as is the read/write control signal. C23 provides power supply decoupling.

The memory contents are preserved on power-down by the transistor buffer arrangement, Q5 and Q6, used to drive the chip select (cs) lines. Q4 inverts one cs signal. Hence when +Vcc is removed, R51 and R52 pull both cs high, switching the memories into low power standby mode.

Switching between 64K and 4K memory systems is performed by SW4. When not grounded by SW4(a), the emitters of Q5 and Q6 are pulled high by R54. Furthermore, because SW4(a) grounds Q1 and Q2 emitters, the 6116 memories are selected (and vice-versa for 64K selection). This way both memory blocks can be connected to the same bus system and switched relatively simply. Pin 11 on IC8 signifies the end of the play-/record cycle. It must also be switched from either A 11, or A 15. A 15 is taken from the inverter, Q4.

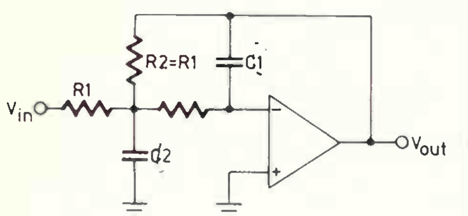


ter components as shown in the circuit diagram.

Once the components have been calculated they must be inserted into the board. If you already have the components of the original 4 kHz bandwidth soldered in they must be desoldered and removed. Be careful when doing this so that the tracks are not removed or damaged while working on them. Desoldering can be done with a 'solder sucker' or desoldering 'wick'. Make sure the components that have been soldered on the top of the board as well are desoldered on both sides.

The new resistors should be 2% metal film types and the capacitors low tolerance 5% varieties.

Testing the filters really requires an oscilloscope and an audio sine wave generator. The anti-alisasing filter can be tested by injecting the signal into the samplers input and raising the frequency until the output of IC1 drops by 3 dB (ie, falls to 0.707 of its pass band level). The 3 dB frequency point should then be the cutoff frequency that you designed the filter for. To determine if it is acting as a true 4th order Butterworth filter, the attenuation rate should be measured. This is done by firstly increasing the frequency until a bit past the 3 dB point. Then increase the input level by as much as possible without distorting the signal as seen at the output.



Now measure the output level (V_{out_1}), increase the frequency by a decade and measure the new output level (V_{out_2}).

The attentuation rate is then:

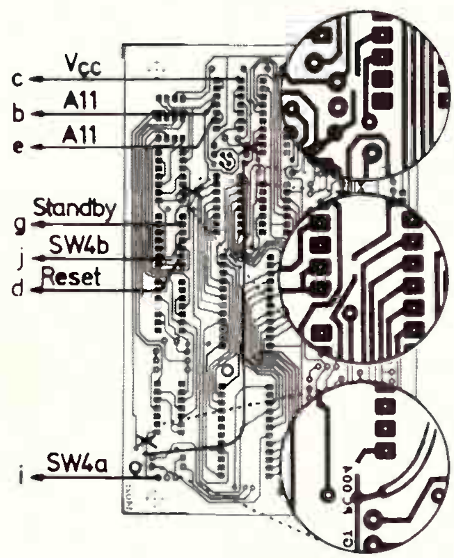
$$\text{Attenuation/decade} = 20 \log \left(\frac{V_{out_2}}{V_{out_1}} \right)$$

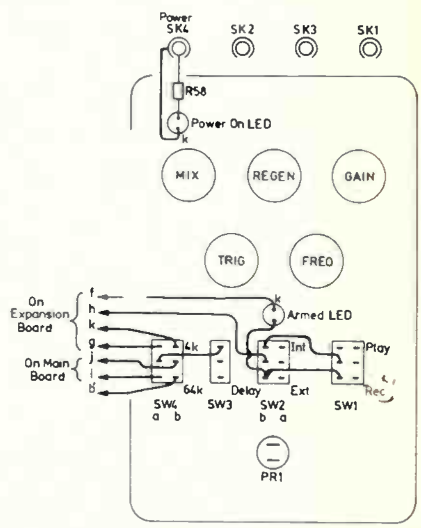
For a 4th order filter this should be around 80 dB/decade.

The clock-reject filter is tested in the same way except the signal must be injected into R15 by raising one end of the resistor off the board. The 6th order filter should have a 120 dB/decade attenuation rate if it is operating correctly. ●

Andrew Robb and Glen Thurecht are electronics engineers and principals in Applied Audio Consultants, based in Canberra. The business is involved in design and manufacture of the NEWTON range of specialist audio equipment, as well as supply of their own ETI project kits.

```
2 REM -- DIGITAL SAMPLER FILTER DESIGN PROGRAM --
4 REM -- WRITTEN BY GLEN THURECHT,   20/1/88   --
6 REM --      APPLIED AUDIO CONSULTANTS         --
8 REM
10 REM ----------- start of resistor data --------------
20 REM
30 DATA 220,270,330,390,470,560,680,820,1000,1200
40 DATA 1500,1800,2200,2700,3300,3900,4700,5600
50 DATA 6800,8200,10000,12000,15000,18000,22000
60 DATA 27000,33000,39000,47000,56000,68000,82000
70 DATA 100000,120000,150000,180000,220000,270000
80 DATA 330000,470000,560000
90 REM
100 REM ------------ start of capacitor data ---------------
110 REM
120 DATA 100e-12,120e-12,150e-12,180e-12,220e-12,270e-12
130 DATA 330e-12,390e-12,470e-12,560e-12,680e-12,820e-12
140 DATA 1e-9,2.2e-9,3.3e-9,4.7e-9,5.6e-9,6.8e-9,8.2e-9
150 DATA 10e-9,22e-12,33e-9,47e-9,56e-9,68e-9,82e-9,100e-9
160 DATA 120e-9,150e-9,180e-9,220e-9,270e-9,330e-9,390e-9
170 DATA 470e-9,1e-6,2.2e-6,3.3e-6,4.7e-6
175 B$ = "y"
176 C$ = "Y"
180 REM
190 REM ------------ start of program ----------------------
200 REM
210 CLS
220 PRINT "-----------------------------------------------"
230 PRINT "   4th and 6th ORDER BUTTERWORTH FILTER DESIGN   "
240 PRINT "-----------------------------------------------"
250 PRINT
260 PRINT
262 LPRINT "-----------------------------------------------"
263 LPRINT "   4th and 6th ORDER BUTTERWORTH FILTER DESIGN   "
264 LPRINT "-----------------------------------------------"
270 INPUT "   INPUT FILTER ORDER (4 or 6) ",ORDER
280 PRINT
290 INPUT "   INPUT CUTTOFF FREQUENCY (Hz) ",W
300 LPRINT
305 LPRINT " ORDER =",ORDER,"CUTTOFF FREQ. =",W
306 LPRINT
308 W = W * 2 * 3.1415926#
310 IF ORDER = 4 THEN GOTO 5000
320 IF ORDER = 6 THEN GOTO 6000
330 IF ORDER <> (4 OR 6) THEN GOTO 210
2000 REM
2010 REM --------------- start of filter section calcs ------
2020 REM
2025 PRINT
2030 INPUT "   INPUT A VALUE FOR C2 AROUND 10/f uF ",C2
2032 PRINT
2034 PRINT "   R1","   R3","   C1","   C2","ERROR(%)"
2035 LPRINT
2036 LPRINT "   R1","   R3","   C1","   C2","ERROR(%)"
2040 X = A*A*C2/8
2050 Y = 0
2053 RESTORE
2055 FOR S = 1 TO (41 + Y)
2060      READ Z
2065      NEXT S
2070 READ C1
2080 IF C1 > X THEN GOTO 3000
2090 S = A*A*C2*C2 - 8*C1*C2
2100 T = A*C2 + SQR(S)
2110 U = T*W
2120 Q = 4/U
2130 RESTORE
2140 FOR H = 1 TO 41
2150      READ Z
2160      IF Z<Q THEN R2 = Z
2170      NEXT H
2180 R1 = R2
2190 K = 1/(C1*C2*W*W*R2)
2200 RESTORE
2210 FOR H = 1 TO 40
2220      READ Z
2230      IF Z < K THEN J = H
2240      NEXT H
2242 J = J-1
2245 RESTORE
2250 FOR H = 1 TO J
2255      READ Z
2257      NEXT H
2260 FOR H = 1 TO 2
2270      READ Z
2275      M = Z/K - 1
2280      E = M*100
2290      PRINT R1,Z,C1,C2,E
2300      LPRINT R1,Z,C1,C2,E
2310      NEXT H
2320 Y = Y + 1
2330 GOTO 2053
3000 PRINT
3010 PRINT "END OF FILTER SECTION ",C
3020 PRINT
3025 LPRINT
3026 LPRINT "END OF FILTER SECTION ",C
3027 LPRINT
3030 INPUT "NEW VALUE FOR C2 ? (Y/N)",M$
3040 IF M$ = B$ THEN GOTO 2000
3045 IF M$ = C$ THEN GOTO 2000
3050 RETURN
5000 REM
5010 REM ------------ 4th order subroutine
5020 REM
5030 FOR C = 1 TO 2
5040      IF C = 1 THEN A = .765367
5050      IF C = 2 THEN A = 1.84776
5060      GOSUB 2000
5070      NEXT C
5080 END
6000 REM
6010 REM ---------- 6th order subroutine
6020 REM
6030 FOR C = 1 TO 3
6040      IF C = 1 THEN A =.517638
6050      IF C = 2 THEN A = 1.41421
6060      IF C = 3 THEN A = 1.93185
6070      GOSUB 2000
6080      NEXT C
6090 END
```





ETI-290 BABYSITTER

If you cannot hear your baby squawking in the room at the other end of the house, then this babyminder project may be just what you need.

Terry Kee

THERE APPEARS TO be a baby boom at the moment, at least in the ETI office with quite a few staff having offspring at very squawkable ages. It therefore should come as no surprise that baby projects are in demand. This one proved to be very popular.

The problem of hearing a baby crying can be quite troublesome, particularly if the infant is located upstairs, or some distance away. The problem is amplified if the doors are closed to shut out noise that may wake the baby. Having noisy guests in the lounge room, listening to music on the hi-fi or just watching TV sometimes makes it impossible to hear if the tiny tot is in distress. The babysitter is designed to alleviate this problem by constantly monitoring the baby's noise via a microphone, and setting off a flashing lamp, or buzzer, connected, via some cable, to a location where you are likely to be.

A sensitivity control has been added to set the threshold for triggering the alarm. A certain amount of intelligence can be read into the display once the level has been carefully set.

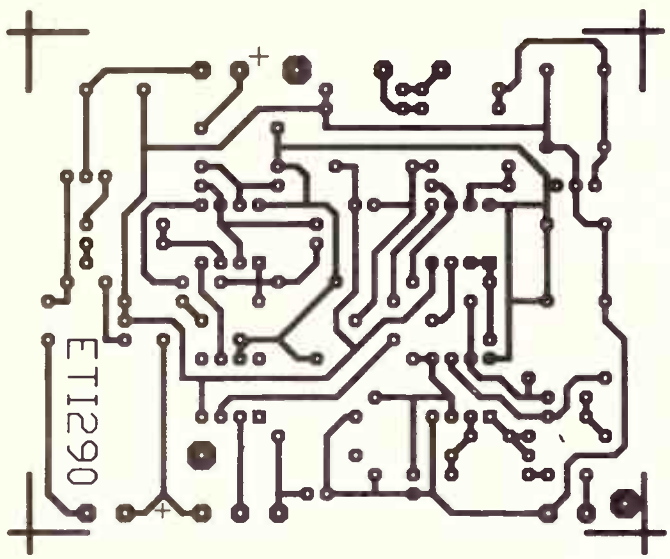
Using the experience of my colleagues with babies, it is worthwhile monitoring the level of the baby's squawks just before they become totally upset and break out into a 120 dB howl! The threshold level can be set to start the lamp flashing constantly at this point. The flashing period is level dependent, so a loud cry or noise will flash the lamp for a longer period than a quieter noise. A continuous cry will flash the lamp continuously. Thus, if the lamp flashes intermittently it is probably safe to assume that the baby is gurgling away quite happily. A constant flashing will indicate that Mum or Dad needs to look into the matter, pronto.

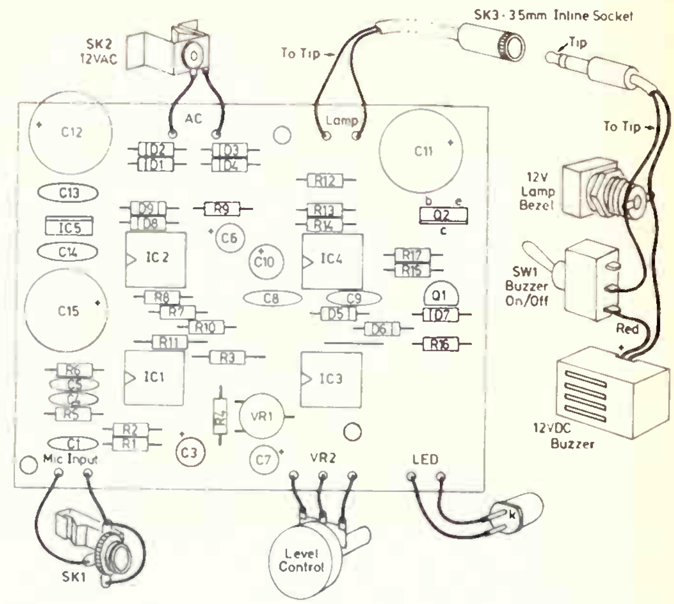
The microphone is connected to the babysitter located close to the baby's cradle. All the electronics are based in the main unit with the power derived from an ac plug pack. The connecting cable to the flasher and buzzer is terminated in a 3.5mm in-line socket, so that an extension cable can be inserted. A switch is also included to switch off the buzzer, if it is not needed. The buzzer is really useful if you are busy doing the ironing or taking a nap and want to be alerted.

The unit is designed to operate with a low impedance dynamic microphone. I used an inexpensive and commonly available microphone, the type that comes with cassette recorders. You may already have one lying around in your odds and sods junk box.

Circuit Description

The microphone signal undergoes fre-





PARTS LIST — ETI-290

Resistors .... all ¼W, 5% unless otherwise stated

R1, R7, R8, R11, R13	10k
R2	1M
R3, R4	100k
R5	1k 1%
R6	100k 1%
R9	1M5
R10	1k8
R14, R15	68k
R16	680R
R17	2k7
R12	22R
VR1	47k axial preset
VR2	10k linear pot
Capacitors	
C1	39n greencap
C2	39p ceramic
C3	100μ electro/25V pc mount
C4, C5	15n greencap
C6, C7	10μ electro/25V pc mount
C8, C13, C14	100n greencap
C9	10n greencap
C10	6μ8 electro/25V pc mount
C11, C15	470μ electro/25V pc mount
C12	1000μ electro/40V pc mount
Semiconductors	
IC1, IC2	TL072
IC3	CA3140
IC4	555
IC5	7812
Q1	BC338
Q2	BD139
D1 to D7	IN4004
D8, D9	IN4148
Miscellaneous	
SK1	3.5mm Jack Socket
SK2	3.5mm DC plug pack socket
SW3	3.5mm In-line socket
SW1	On/Off Miniature Toggle switch
LED	Red Led

Plastic Zippy Boxes (50 x 90 x 150)mm and (28 x 54 x 83)mm; 1 x Knob; 1 x 3.5mm Jack Plug; 1 x 12V ac plug pack at 300mA; 1 x 12V lamp bezel; 1 x 12V dc buzzer; 1 x low impedance dynamic cassette recorder type microphone; twin core flex (length dependent on requirements).

quency response shaping so as to minimise extraneous noise from triggering the babysitter. Loud and short transient type sounds like a door slamming will trigger the alarm unit only for a short time period and the unit will reset itself. Normal conversation in the room will not set it off. The difference between the average ambient room noise level and that of a baby crying is large so it is easy to set the trigger level above the ambient noise of any room. The unit may also be used in other applications where a noise needs to be detected.

The signal picked up by the microphone is amplified in a frequency selective amplifier with a maximum gain of 40 dBs at 1 kHz. The 3 dB points occur at 400 Hz and 4 kHz. To enhance the selectivity at frequencies where the baby's squawk is concentrated, the signal is passed through a bandpass filter set to pass frequencies around 1 kHz. The filter that is used in the babysitter also provides an additional 30 dB of voltage gain at 1 kHz. The microphone signal is then converted to a dc level with its value corresponding to the peak of the waveform. The peak voltage will follow the microphone signal with a fast attack time but with a slow release time constant of about 10S. It is this function that makes the alarm period dependent on amplitude. A larger level will hold the peak voltage for a longer period above the trigger level than a smaller amplitude.

The peak voltage is then fed to a comparator whose output is triggered high when the peak voltage exceeds the threshold voltage set by the level control. This signal then enables an oscillator to drive the flasher and buzzer driver at about 1 Hz. The oscillator output also flashes a

ETI-290 — HOW IT WORKS

The microphone amplifier is configured around IC1a with an input impedence of 10k ohms and a maximum gain of 40 dBs. The ac coupling capacitor C1 along with R1 attenuates low frequencies and sets the −3 dB point to 400 Hz. The feedback capacitor C2 limits the high frequency response and provides a −3 dB point at around 4 kHz. To further enhance the selectivity, the bandpass filter that is configured around IC1b has a centre frequency occurring at 1 kHz, Q of 5 and a gain of 34 dBs.

The design equation for this multiple feedback bandpass filter are:

$fo = 1/2\pi C\sqrt{R5 x R6}$,
$Q = 1/2 X\sqrt{R6 x R5}$,
$Gain = -2Q^2$
where $C = C4 = C5$

If you want to vary the centre frequency to make the unit sensitive to a different frequency, then it's simply a matter of scaling C4 and C5. The Q factor should not be made higher than 5 to try to improve the selectivity, as it will go unstable.

The positive signal peaks are detected by IC2a and D9. The peak voltage is stored in C6 and R9 provides a discharge path with a time constant of about 10S. R10 protects IC2b from discharge currents. IC2b is a high impedance voltage follower that buffers C6 and it is included in the feedback path to minimise offset voltages.

IC3 is a comparator that has it's threshold level varied by the level pot VR2. The preset VR1 is used to set up led which is located in the main unit to facilitate easy setting up of the alarm trigger level. This facility enables the threshold level to be set up in the same room as the baby's cradle. Power is derived from a 12 Vac plug pack and the rectifier, 12V regulator and associated power supply components are contained on the pc board.

Construction

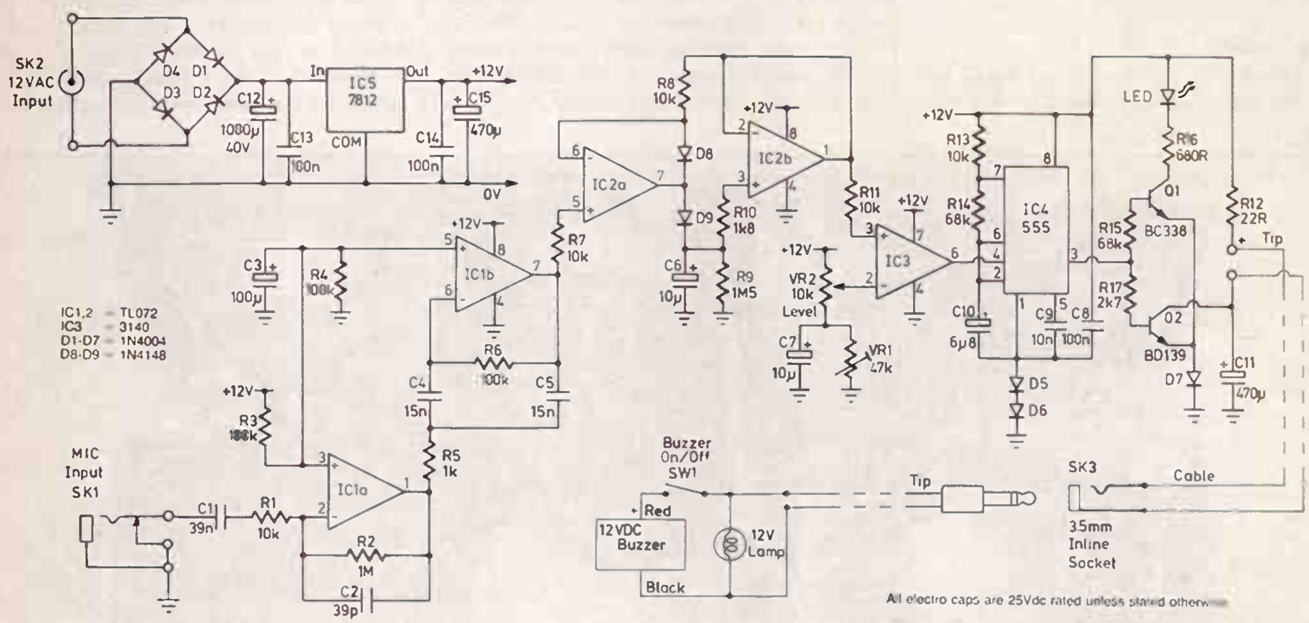
All the electronics are mounted on a pc board measuring 81mm x 67mm. Once you are confident that the pc board is satisfactory then you may start by mounting and soldering in the link, resistors, capacitors and preset. Take note of the correct orientation of the polarity of the electrolytic capacitors, refer to the component overlay. If you have decided to use ic sockets then these can now be mounted and soldered in. Insert the transistors op-amps, diodes and 12V regulator making sure of their correct orientation.

Next comes the wiring of the pc board and associated bits and pieces into the box. A front panel is not included as the type of plastic box is not critical and the choice is left to the reader. I used a plastic zippy box measuring 50 x 90 x 150mm and letrasetted the top panel. Mark out the holes for the 3.5mm microphone jack socket, pot, led, plug pack socket and twin core flasher cable and drill the holes. The flasher cable should enter the box via a rubber grommet with an anchor clamp or alternatively tie a knot to fasten the cable down. Cut the pot shaft to a length to fit the knob and mount all the hardware in to the box. Wire in the microphone socket with a short piece of audio screened cable. Note that the microphone input is grounded when the plug is not inserted. The rest of the wiring can be done with hook up wire (refer to the wiring diagram). Note that the polarity of the ac plug pack is uncritical. Next, mount the 12V lamp bezel, switch and the buzzer into a box. I chose to use another plastic zippy box measuring 28 x 54 x 83mm. Wire in the hardware as per the wiring diagram. I mounted the buzzer on the lid of the box and it was loud enough when it was fastened down. However, if you want it louder, drill a couple of holes on the front panel to allow the sound to emit. Cut a short length of twin core cable with it terminated in the 3.5mm jack plug and clamp down the cable with a knot tied inside the box.

The length of the flasher cable will vary according to user requirements, however terminating the main cable in a 3.5mm inline socket allows the cable to be extended, if needed.

Testing

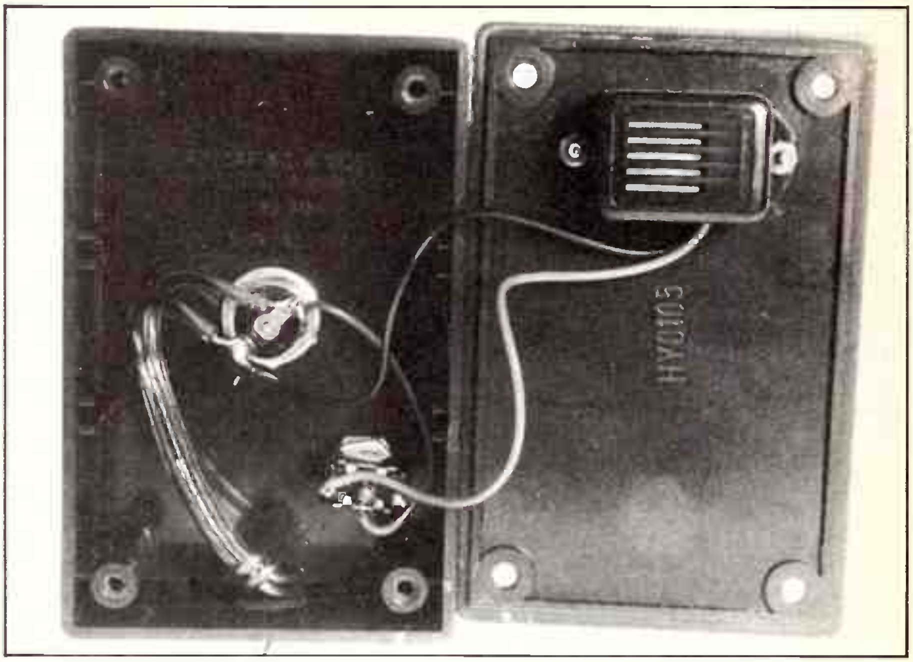
Check the pc board for dry joints and watch out for solder splashes shorting adjacent tracks or pads. Connect the 12V ac



All electro caps are 25Vdc rated unless stated

the minimum sensitivity with no microphone connected to the unit. The comparator output (pin 6 of IC3) goes high when the unit is triggered and stays low otherwise. This signal is used to reset the 555 timer (IC4) which is configured as a conventional 1 Hz oscillator. R13, R14 and C10 determines the frequency of operation. When the Reset input (pin 4) is taken low then the oscillator is disabled and the output is taken low. The Reset pin requires it's terminal to be taken below 0.7V to operate correctly. Since the op amp output (IC3) cannot be guaranteed to achieve this low voltage swing, the 555's ground reference is lifted by around 1.2V using diodes D5 and D6. The output of IC4 (pin3) then drives the LED driver which is configured around Q1 and the 12V lamp/buzzer driver, Q2. R12 limits the lamp current and C11 is used to smooth out the current surges caused by the switching action. The 12V dc buzzer gets connected across the 12V lamp when it is switched into circuit, via SW1.

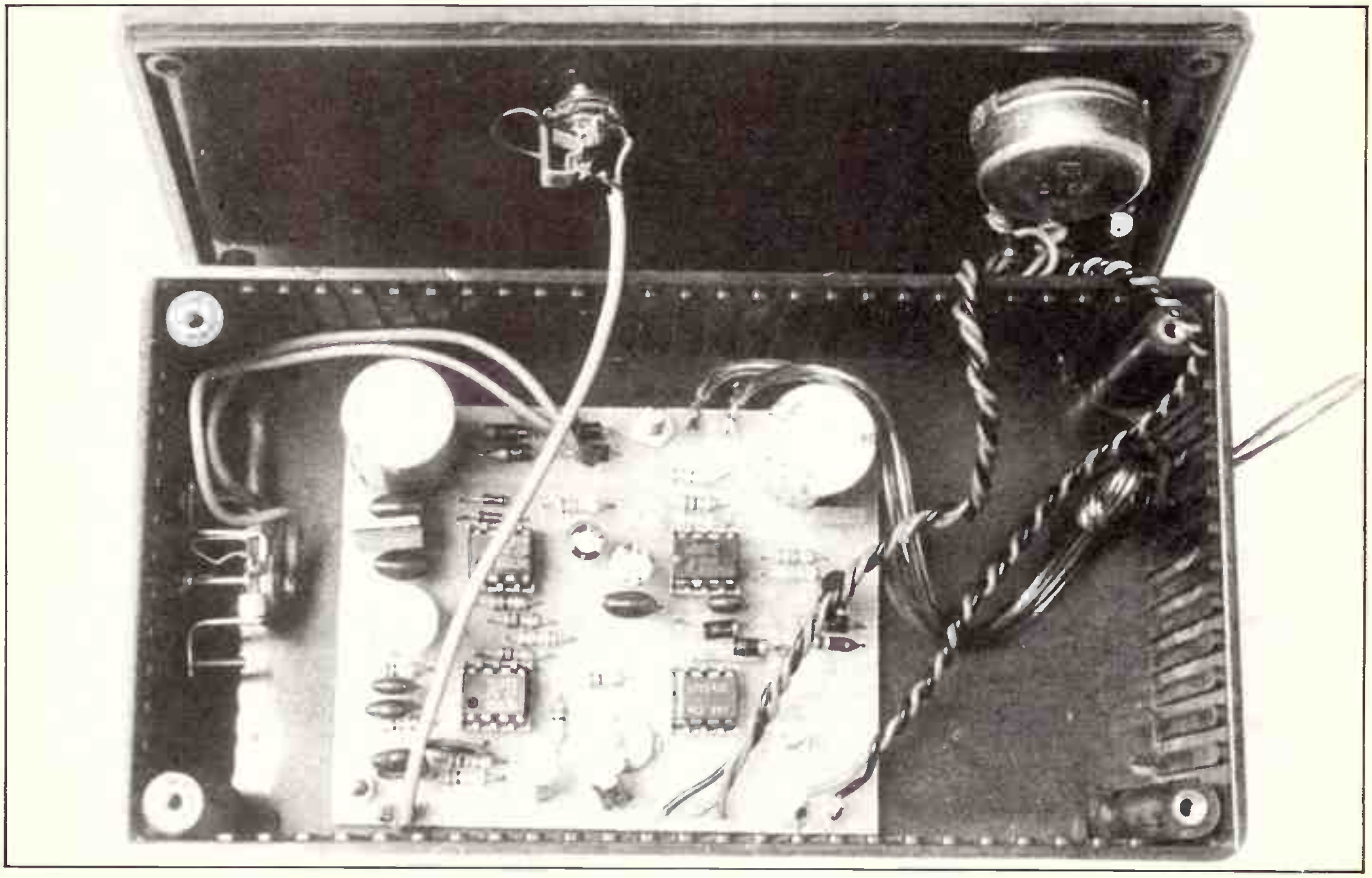
plug pack and switch on. Measure the dc voltage across the supply rails and check that it is within +/− 250mV of 12V. Once that has been ascertained, then it is time to set up the preset, VR1. The op amps are biased to half the supply rails by R3 and R4. The minimum threshold voltage at pin 2 of the comparator (IC3) will vary according to the tolerance of R3 and R4 and VR1 is used to compensate this. With the microphone disconnected from the unit, turn VR1 fully anti-clock wise with small screwdriver. Rotate the level pot to it's minimum sensitivity ie, with the wiper voltage connected to ground. Once this is done, the LED should be winking at you. Slowly rotate the preset VR1 clockwise until the LED just stops flashing. Do the adjustment slowly, as you may accidentally set the minimum sensitivity too high. Back off the preset anti-clockwise a little bit to check that you have not overadjusted it. The unit is now set up and it's time to test it. Plug in the microphone and a gentle tapping should set the LED flashing. Check that a louder noise triggers the alarm for a longer period.



Installation

The unit is now ready to be installed. Locate the unit next to the baby's cradle with the microphone placed in a convenient position close to the baby's head. The head board is probably as good a place as any. Ensure that the microphone is taped down securely and that the microphone cable is out of the baby's reach.

At the other end locate the box that houses the flasher lamp and buzzer in a position that can be easily seen, the mantelpiece or top of the TV set is a good location. Use some double-sided tape to fasten the box down onto the surface. ●



CHARGE-COUPLED DEVICES

Alan Denby

Charge-Coupled Devices (CCDs) belong to a family of solid-state devices called Charge-Transfer Devices (CTDs). This family of devices also includes Bucket Brigade Devices (BBDs). In essence they are simple units which work as shift registers formed by a string of closely spaced MOS capacitors. They can store and transfer analogue-charged signals, either electrons or holes, that may be introduced electrically or optically.

CCDs were invented as recently as 1970 by W.S. Boyle and G.E. Smith at Bell Laboratories. They were looking for an equivalent to magnetic bubble memory which could be manufactured with silicon technology. These devices have found uses in many fields, including: image sensing, analogue signal processing and memory applications.

The idea of using capacitors as a means of storing information is not new. In 1952 Jansen proposed a system of ideal buffer amplifiers and switches which could be used to transfer information (see Figure 1a) and in 1965 these circuits were implemented to provide a variable analogue delay. These circuits were known as Bucket Brigade Devices. In 1967 the idea was revised and implemented with bipolar transistors (see Figure 1b) and subsequently with MOSFETs (see Figure 1c).

A CCD cannot be represented by discrete components but operates in much the same way as a BBD. CCDs are, in fact, closely spaced capacitors on an isolated surface of a semiconductor. The capacitor electrodes when pulsed in the proper sequence generate a series of moving potential wells which can carry packets of minority carriers.

The MOS Capacitor

The basic element of many CCDs is the MOS capacitor. Figure 2a shows a MOS capacitor formed by a metal electrode attached to a thermally oxidised p-type silicon substrate. If a positive voltage is applied to the electrode the majority carriers are repelled and a potential well is formed at the surface which is initially depleted of free carriers. Minority carriers, electrons in this case, are thermally generated in or near this well and will accumulate at the interface. Even though the charge accumulates at the interface it is convenient to think of the potential well as being a bucket and the minority charge as a fluid that partially fills it (Figure 2b).

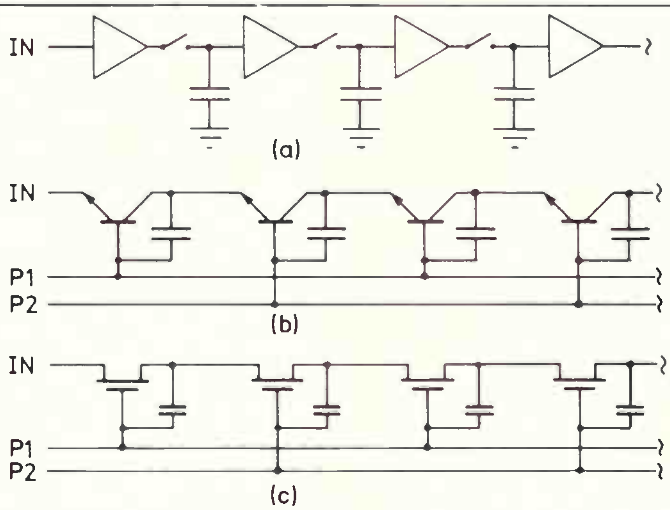


Figure 1: A system for storing information. At the top, a system of ideal buffers and ideal capacitors could be used to transfer information from left to right. A practical application was the Bucket Brigade. At centre, a revision of the basic ideas using bipolar transistors, and at bottom, a mosfet version.

Surface Channel Charge-Coupled Devices (SCCD)

If two MOS capacitors are placed close together so that their depletion regions overlap then any mobile minority charge will tend to accumulate in the region of highest potential. In terms of the bucket model this means that the fluid will flow up to the deepest part of the potential well. If a charge packet is present in a potential well it will spread over this well and into the adjacent one if it is at an equal or greater potential (Figures 3a, b). By reducing the potential of the original storage well the charge transfer is completed (Figures 3c, d). By stringing together several such devices a number of charge packets can be transferred at the same time.

To ensure that transfer is only in one direction, three-phase clocking is required. By using asymmetrical electrodes a two-phase clock can be implemented. In some implementations a four-phase clock is required. In this type of CCD the charge is contained in two adjacent potential wells thus doubling the signal that can be transferred by the device.

Bulk Channel Charge-Coupled Devices (BCCD)

SCCDs store the charge at the silicon-silicon dioxide interface. This can limit the performance due to the interaction of the charge with interface states. This problem can be overcome by the use of bulk channel CCDs. A layer of silicon of opposite polarity to the substrate is implanted at the surface and shifts the region of maximum potential away from the interface and into the bulk. This layer is in electri-

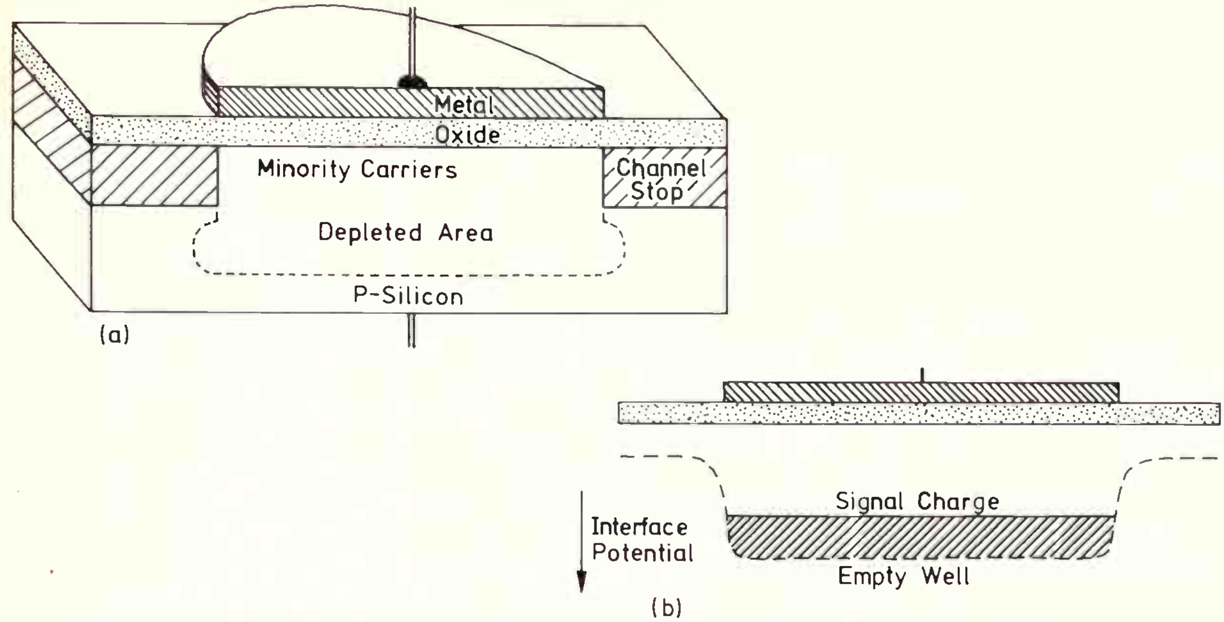


Figure 2: Inside a capacitor using Metal Oxide Semiconductor. It works on the basis of potential wells and carriers that can fill them. The lower diagram represents a well filling with charge as a result of the action of the carriers.

cal contact with the input and output diodes of the CCD which drain out all mobile carriers under a suitable reverse bias. This forms a large potential well in the form of a depleted bulk channel. Mobile signal charge will reside near the potential maximum. The clock pulses applied to the electrodes will modulate the channel potential and give rise to the moving potential wells which can store and transfer charge packets.

Input and Output

There are three methods by which a charge packet can be placed into a potential well: dark current, photoelectric carrier generation and electrical charge injection. Dark current is a source of noise and signal degradation while photoelectric generation is the method used in CCD imaging arrays.

There are several methods of electrical injection all of which employ an input diode. The simplest form is dynamic current injection where a signal is applied to the input diode with reference to the potential of an input gate. The first potential well is then pulsed and the charge transfers from the diode across the input gate and into the well (Figure 4a). This method, however, has poor linearity as it depends on the gate potential, the depth of the potential well, the pulse time and therefore the clock frequency.

A better method (Figure 4b) fills the first potential well with signal from the input diode while the input gate is open. The gate is then turned off and the charge packet, isolated from the input diode, is ready for transfer.

A third method (Figure 4c) involves alternately pulsing the input diode to overfill the first potential well and then drain-off the excess to the level of the input

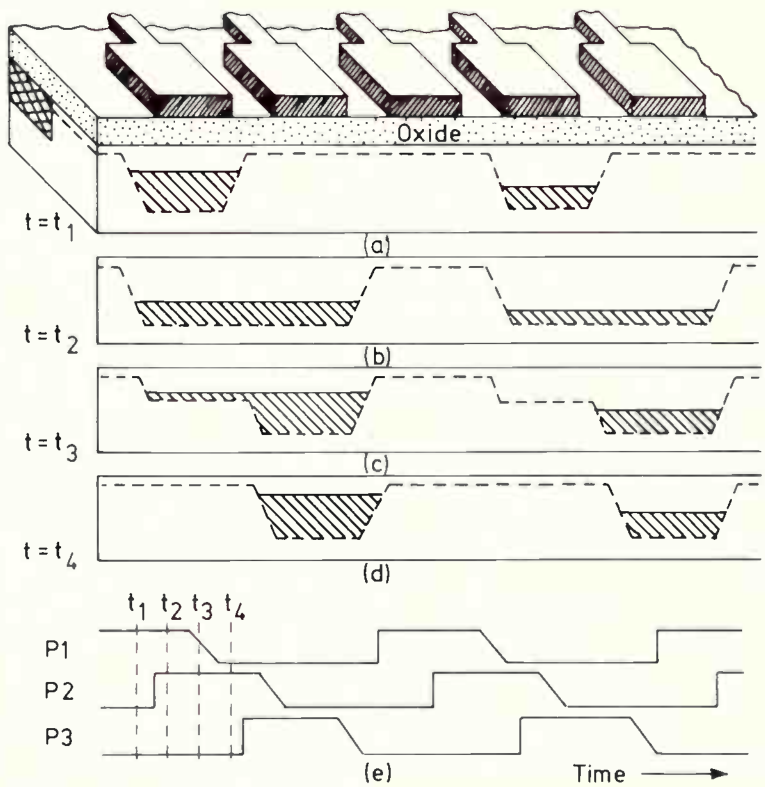


Figure 3: At the top is a schematic diagram of a three phase n channel CCD with its wells shown in the silicon. The lower diagrams illustrate the sequence of transfering charge, with a time diagram at the bottom.

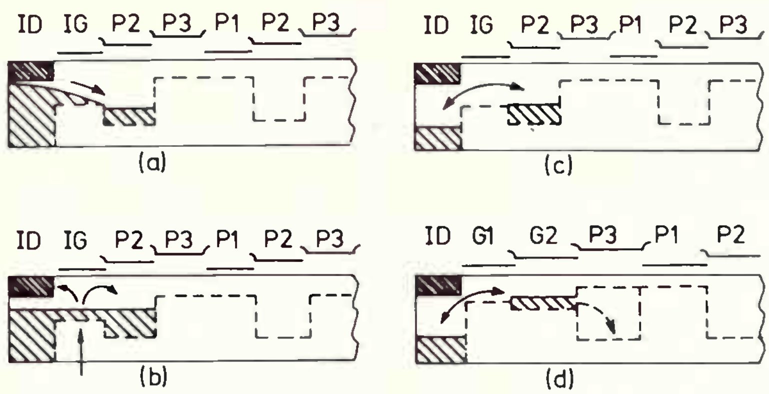


Figure 4: A bucket brigade as in figure 1 but in using MOS capacitors.

gate. This is the potential equilibrium or 'Fill and Spill' method.

Another method uses a second input gate in conjunction with potential equilibration. The second gate is held at a constant potential and less input noise is generated because this gate is not clocked (Figure 4d). Experimental results indicate that this method offers the best linearity and low noise.

Output signal detection can be accomplished by passing the charge into the depletion region of an output diode where it is sensed by a current-sensitive amplifier. This method is destructive and the charge signal is lost once read. A second, non-destructive method detects potential changes on the floating gate of a MOSFET output transistor. By using non-destructive detection the charge packets can be sampled at several intervals along the CCD array. This has applications in signal processing.

Noise signals

An important consideration in CCDs is their ability to transfer charge packets from one potential well to the next without altering the signal in any way. Each time a charge is transferred a small portion may be left behind or some additional charge may be added.

Transfer efficiency was orginally defined as the fraction of charge that was transferred correctly from one well to the next. In some cases it is also used to describe the difference between the input and output signals for the complete device. It is also convenient to define the transfer inefficiency.

$$\epsilon = (i - \eta)$$

Thus, the inefficiency product for the CCD containing η cells is $\eta\epsilon$. Transfer inefficiencies for single cells of between 10^{-3} and 10^{-4}, are not uncommon. The signal that is left behind at each transfer accumulates in the potential wells to produce transfer noise. This noise signal is influenced by input signal level and clock speed as well as some random fluctuations. Transfer noise is also contributed to by interface state noise in SCCDs and bulk trap noise in BCCDs.

Integration noise occurs during the period that charge is stationary in a potential well. This can take the form of dark current noise, where electron-hole pairs are generated in the potential well, or thermal noise. In image sensing devices integration noise is caused by incident light. Noise can also be generated by the input and output sampling circuits of the CCD.

In order to minimise the effect of transfer noise and integration noise, a small charge packet that corresponds to a zero input sample is introduced into the CCD. This is known as a Fat Zero and is typically 10 per cent of the maximum charge packet.

CCD Image Sensors

Some of the first experiments with CCDs involved the imaging of visible light. These early CCDs had no region into which charge could be injected, and the potential wells were filled by generation of electron-hole pairs from incident photons. As image sensors CCDs offer many advantages over the more conventional vidicon tube. Some advantages are: low thermal noise, low-light-level performance, flat spectral response, low cost, small size and low power consumption.

There are two basic types of CCD imaging devices: the linear imaging array which consists of a single row of photosensitive elements, and the area array which has these elements arranged in a two-dimensional matrix.

Linear Image Sensors.

These devices are used as one-dimensional sensors for such applications as fluid depth in tanks. To achieve two dimensions with a linear array the second dimension must be mechanically scanned. This may be done with a rotating mirror or more often by moving the object to be scanned over the array. With this type of device high resolutions can be obtained with several million resolution spots. Linear arrays are found in many modern facsimile transmission systems.

The simplest form of linear array is one in which integration occurs in the transfer channel (Figure 5a). This type of device must be clocked so that shift-out time is very much less than integration time. If not, smearing problems will arise when the charge is transferred through light-sensitive regions. One method of overcoming this is to place some form of electrical or mechanical shutter over the array during the transfer process.

A better method is to use separate sensors and readout registers (Figure 5b). After integration is completed the charge packets are shifted into the register which is clocked out during the next integration period.

The shift register is not exposed to the incident light which helps to eliminate the problem of smear. A third type of linear array is constructed from a separate sensor and two shielded readout registers (Figure 5c). Odd elements are shifted left into one register and even elements shifted right into the other. These can then be clocked out and recombined. The major advantage is that half the number of transfers is required to read any one element or pixel.

The first commercially available linear array consisted of 500 elements with a cell length of 60 μm and separation of 30 μm. Thus it had a total length of 4.5 cm. More modern linear arrays have a sampling pitch of 5 μm and contain 5732 sensor elements. This is a ten-fold increase in image solution.

Area Imaging Arrays

In order to generate real-time pictures at the required rate for broadcast TV, the CCD must be scanned electronically in two dimensions. The simplest form of this is to arrange a number of linear sensors in a two-dimensional array (Figure 6a). A common readout register can then be used to access the charge information. This system is both slow and prone to smearing.

A better approach is that of a frame-transfer CCD array. This involves the use of vertical rows of imaging cells to form a two-dimensional array. A second array of the same size which is shielded from the light source is required below the imaging area (Figure 6b). The exposed area is integrated, then during the vertical retrace period of the video signal the whole array is shifted quickly down into the shielded area. When the transfer is complete the upper region starts integration for the next frame. During each horizontal blanking period the stored area of signal is shifted down one row at a time into the shift register. When this signal is shifted out horizontally it forms the video signal. After complete transfer of the stored area the next image is then ready for frame transfer. The simplicity of the electrode arrangement offsets the problems associated with the need for an extra storage area and the smearing or blooming effects that can occur.

The first frame-transfer CCD had a resolution of 106 x 128 pixels and used three-phase clocking. Recently a high-density 604 x 576 pixel, frame-transfer CCD with antiblooming structure was released .

Interline transfer arrays allow charge to accumulate at separate integration sites before each element is clocked horizontally into a vertical shift register. This requires only one transfer to remove the whole frame from the light-sensitive area. During each horizontal blanking period the vertical shift registers shift one line down until they have all been read out at which point integration of the next frame is completed and the transfer process is repeated during the vertical retrace. By designing two integration sites for each element of the vertical register it is possible to achieve the required interlacing by transferring the charge from alternate sites. This type of CCD array is simple in operation but requires more complex cell design and reduces the light-sensitive area because of the need for light shields over the transfer channels.

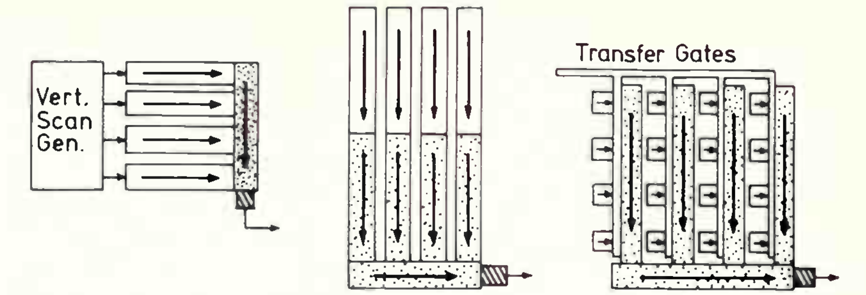


Figure 6: Linear arrays. At left is a line addressed CCD. In the middle frame transfer and at right, interline transfer.

The first commecially available CCD interline image sensor was a 100 x 100 pixel device. This had sensors measuring 18 x 14 μm and employed bulk channel registers. More recently, a ⅔-inch CCD interline transfer image sensor was developed, with 768 x 490 pixel resolution and 1.5 μm element pitch. The most important parameter in imaging arrays is the signal-to-noise ratio. Bulk channel devices are best suited for low noise applications.

Colour CCD Sensors

The first colour camera employing CCD imaging devices was demonstrated in 1973. This used three 106 x 128 element CCDs and a beam-splitting prismatic assembly of dichroic mirrors. The light was filtered into the three primary colours each of which fell onto individual CCD targets. Modern CCD cameras employ single-chip sensors. These devices contain colour filters on their surface. The filters can be arranged in vertical stripes or in a checkerboard pattern depending on the type of device and its application. With frame transfer devices the colour filters are usually arranged in vertical stripes of red, green and blue (RGB). Each coloured row is transferred into its own horizontal shift register to separate the three colour signals.

The relative colour intensities must be matched and in some cases two green stripes may be present for each pair of Red and Blue. This gives the filter an RGBG pattern.

With interline transfer devices a checkerboard pattern of red, green and blue filters is more often used. Because of the precise control and transfer that can be achieved with digital clocking, it is not difficult to reconstruct the colour matrix into the required colour components of the video signal.

Each colour pixel is comprised of three or more individual sensor elements. To achieve the same resolution as a monochrome sensor, the packing density of the sense elements must be three or four times greater. This is the main reason that colour CCD cameras are not widely used for broadcast applications. A number of near-broadcast-quality three-chip colour cameras are currenlty available. These replace the three conventional vidicon tubes with CCD sensors.

Infrared CCD Sensors (IRCCD)

Infrared CCD sensors are of two types, monolithic and hybrid. The monolithic IRCCD has the CCD substrate constructed of an IR-sensitive material. The IR source causes photo-emission directly in the potential wells of the CCD. With hybrid types, the IR radiation is sensed by an array of IR detectors of any suitable material and these are interfaced with the silicon CCDs which perform the readout function.

Modern IRCCD image sensors use Schottky-Barrier detector arrays in a

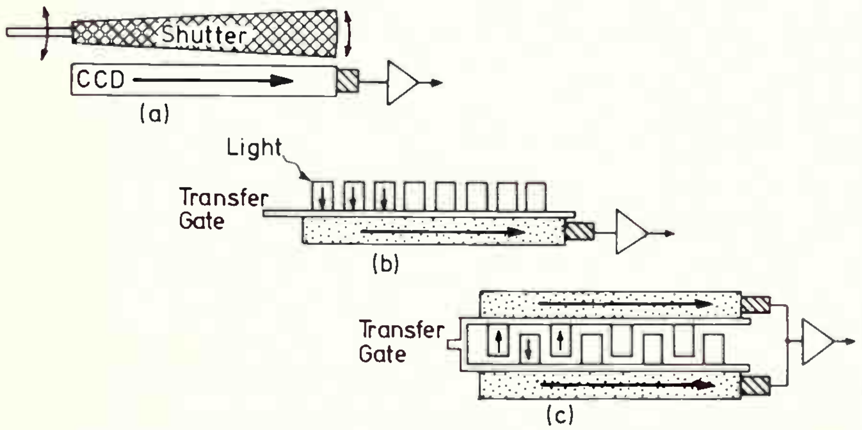


Figure 5: Different forms of linear image sensor.

monolithic structure for image sensing in the short wave IR (SWIR 1-3 μm). These devices have applications in the areas of defence, surveillance, medicine and astronomy. IRCCDs are being used in the Hubble Space Telescope which is to be launched when shuttle flights resume.

IRCCDs are also under development at the University of NSW where they have been used in conjunction with the Anglo Australian Telescope for imaging of stars.

CCD Signal Processing

The CCD is a sampled anlogue device. Each charge packet represents the value of an analogue signal sample. The simplest form of CCD signal processor is the serial-input/serial-output device, which operates as an analogue delay line. Although the delay line itself is a useful device, this is not the only signal processing application that CCDs perform. Serial-to-parallel and parallel-to-serial manipulations can be performed, making the device useful as a multiplexer/demultiplexer.

Clocking frequencies of 10-20 MHz are achieved with transfer inefficiencies of 10^{-4} to 10^{-5}. Some deep-buried channel devices have been clocked at frequencies of 200 MHz and some experimental results suggest that a clock frequency of 900 MHz is possible.

The transfer of charge is controlled by a digital clock which ensures precise timing of the CCD circuit. Charge samples may also be sensed non-destructively at any point along the CCD by using floating-gate amplifiers. This is useful for transversal filter implementation.

The serial-input/serial-output (SI/SO) structure has use as a coherent analogue delay (Figure 7a). It can be used as the delay component in recursive filters and as a variable data rate buffer for time-base compression or expansion. CCDs have a charge dynamic range in the order of 10^4 to 10^5 and delay bandwidth products of a few thousand. The sampled nature of the device requires that some consideration be given to effects such as aliasing and aperature time.

The PI/SO structure (Figure 7b) finds application as a multiplexer, delay-and-integration (or delay-and-add) processor, or for transfersal filters.

The SI/PO structure (Figure 7c) is most useful for transversal filter applications. It has been used for spectral filtering, transform calculation, and convolution/correlation. The critical components are the sense amplifiers and the signal weighting circuits. The dynamic range will be limited by these circuits.

A combination of these structures (Figure 7d) can be used to obtain large delay-bandwidth products. Once the signal is past the initial input circuit, it is handled entirely as charge packets.

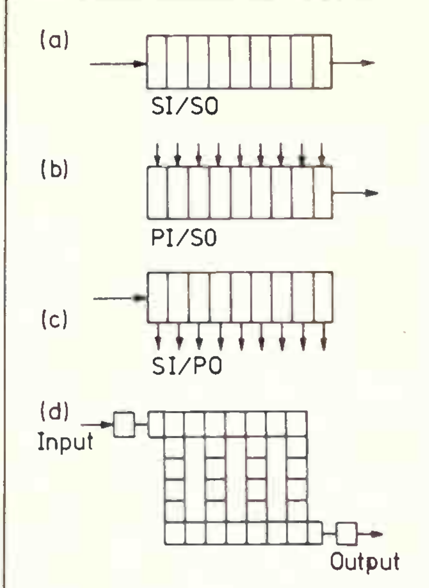


Figure 7: Using CCDs as serial to parallel and parallel to serial processors.

Transversal filters, as a general class of filter, use time-delayed signals which are weighted and summed with the correct sign to produce a wide range of filter implementations, with a finite inpulse response. This may be achieved simply with CCDs by the use of non-destructive sense amplifiers and external weighting and summing circuits. A more elegant approach to this problem is to use a CCD with a split electrode structure (Figure 8).

The electrodes of one clock phase are split into two sections of varying size and are clocked together. The charge which flows into each portion of a split electrode is dependent on the size of the electrode and the signal charge flowing into the region under the electrode. By measuring the difference in charge flowing into the two parts of the split electrode, non-destructive sampling and weighting is performed simultaneously. Since the P2a electrodes are tied together, as are the P2b electrodes, the summation is done automatically. The output of the transversal filter is simply the integral of the signal differnce on the P2a and P2b clock lines. This is performed by the differential current meter.

Digital Charged-Coupled Logic (DCCL)

CCDs are inherently analogue devices but can be used in digital applications. A nearly full charge well is used to represent a binary 1 and a nearly empty well to represent a binary 0. Under these conditions input linearity is not important and a refresh circuit is easily implemented some distance along the CCD. Shift register implementation is straightforward and the basic logic functions as well as some more complex functions are performed with CCD logic.

CCD Memory

Although CCDs were originally intended for digital memory, use this is the area in which they have had least success. When used as a memory device, access is obtained serially to any single bit and can take a long time compared to RAMs. This longer access time means that they must be cheaper or have a higher bit density than RAMs if they are to be competitive.

A non-volatile analogue memory device has been constructed fusing MNOS/CCD techniques. After 100 hours of storage, signals are attenuated to 60 per cent of their initial value with a linear dynamic range of 35 dB. ●

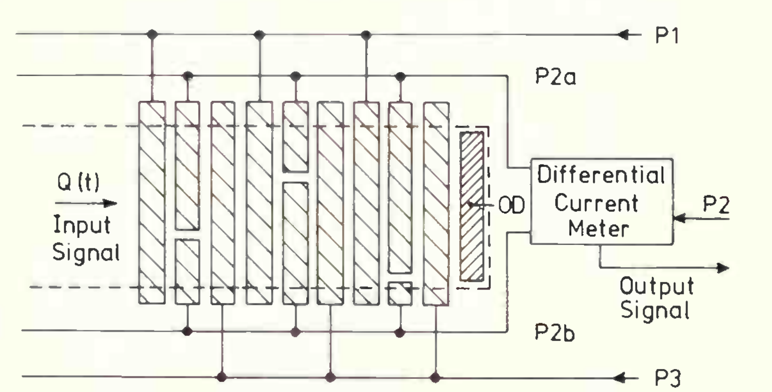


Figure 8: A transversal filter using split electrodes.

Radioactive

RADIOACTIVTY has been something of a preoccupation, of course, ever since that business blew up in the Ukraine. The latest item of Chernobylia to come to our attention is an article about the radiation you're exposed to while reading magazines.

Under the headline "Radiant Spiegel" Hamburg's *Die Welt*, a conservative daily, explains how, at a reading distance of 35 centimetres, people foolished enough to read *Der Spiegel*, a leftish weekly on glossy paper, expose themselves to radiation levels of 30 picosieverts an hour.

Physicists at the nuclear research institute in Karlsruhe said that this was 20 times higher than the 1·5 picosieverts an hour that people inflict on themselves while watching a television 3·5metres away. The physicists pointed out, however, that both values pale in comparison to background levels.

The main culprits for magazines, apparently, are the fillers and whiteners in the paper, such as barium sulphate, calcium bicarbonate and barium carbonate. According to the nuclear physicists, a typical issue of *Der Spiegel* contains about 20 becquerels per kilogram of radium-226, and about 19 becquerels per kilogram of thorium-232. A single issue has about 8 becquerel of each.

The effect of reading ETI have not been assessed, but we suspect that it does not constitute a risk to health in Australia.

Different Units

The main problem with radioactivity, is that few people understand the units. One astute reader suggest that we do away with becquerels, sieverts and the like, and adopt instead a new system of units based on the concern. The units would be defined as follows:

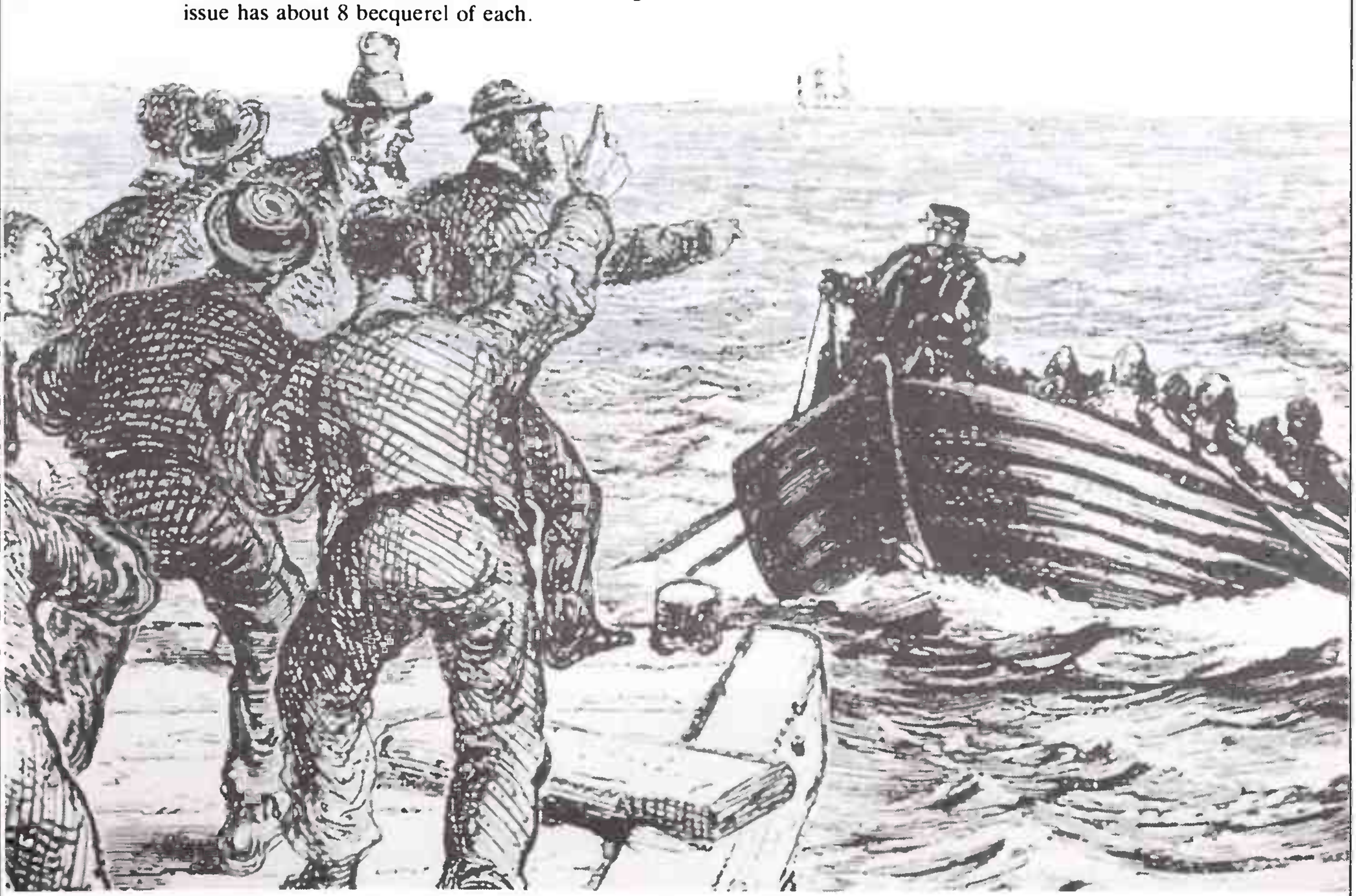
A microconcern: someone at Lucas Heights forgot to lock up their overalls.

A milliconcern: enough luminous sheep in 5A to threaten the loss of a marginal seat in a by-election.

A kiloconern: a disaster a government said wasn't one, eg, Three Mile Island.

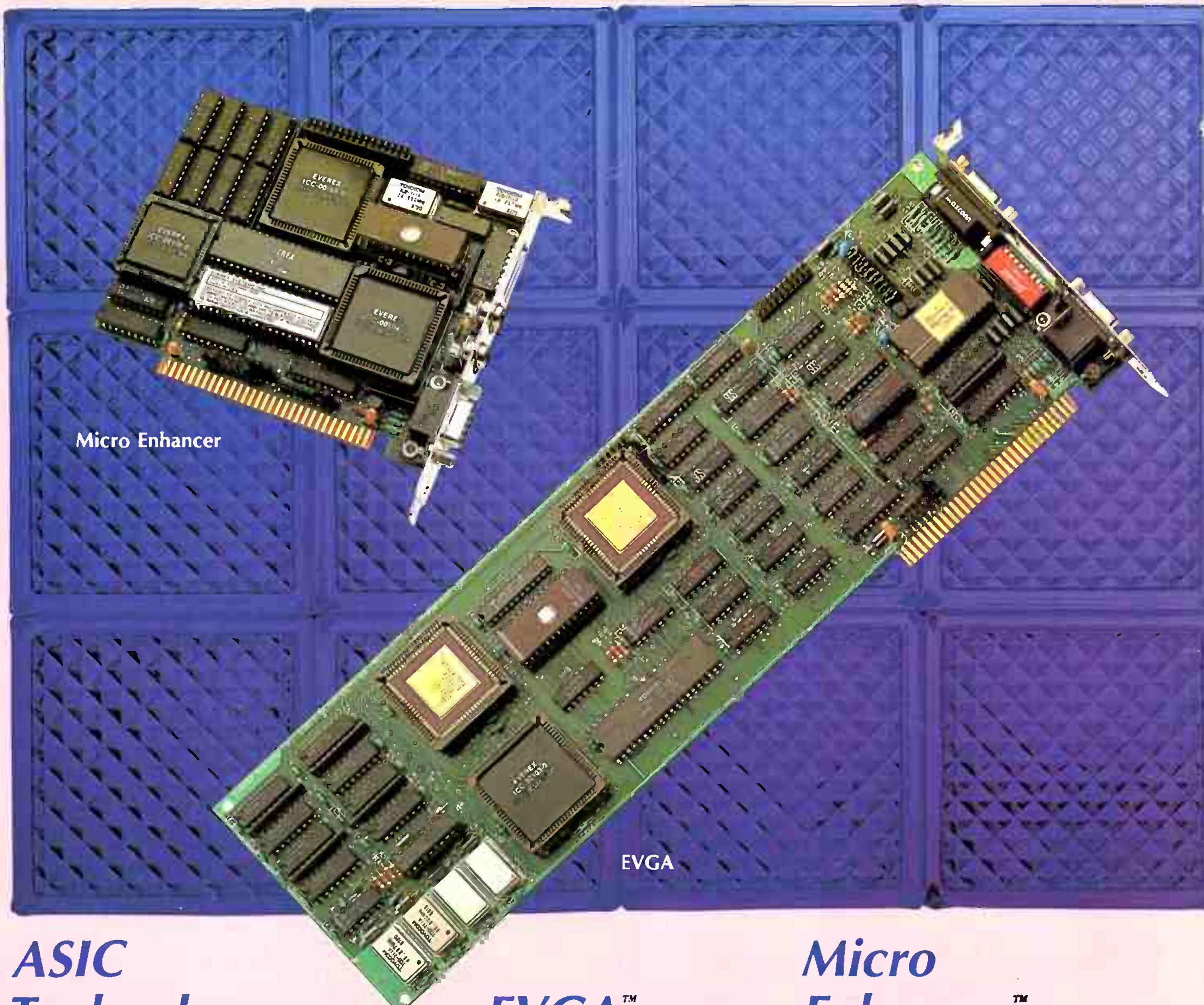
A megaconcern: a disaster that everyone knows damn well was one, whatever the Number 3 in the Politburo says.

It is suggested that scientists should beware of announcing too often that "there is no cause for concern". Five "no concerns" would trigger off a suspicion reflect, resulting in mass hysteria, a Royal Commission and the resignation of the government.



The Aran Islanders have always been keen supporters of ETI. Here we see their glee as they rush to learn who won the Data Sat modem competition.

Everex — the #1



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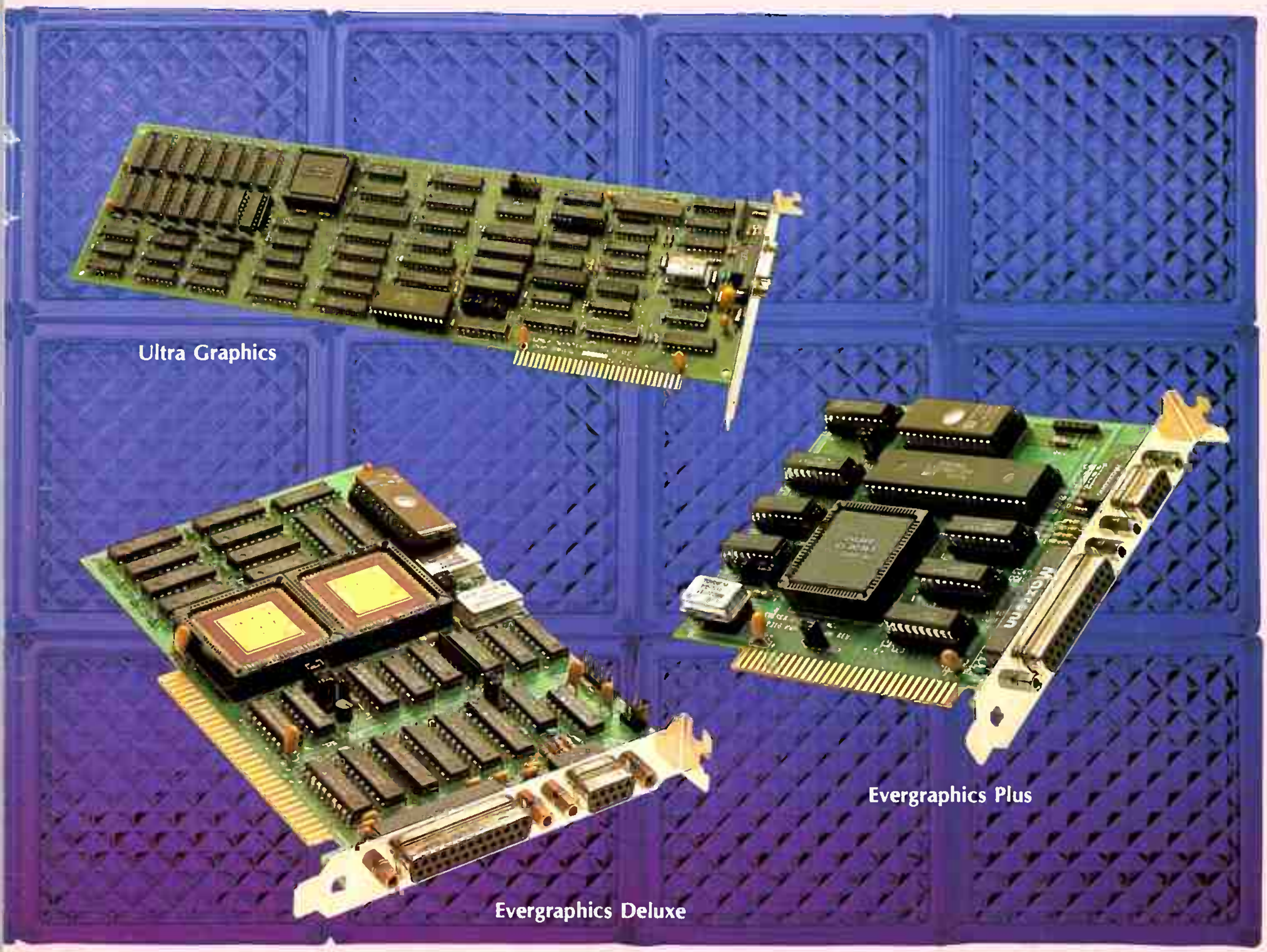

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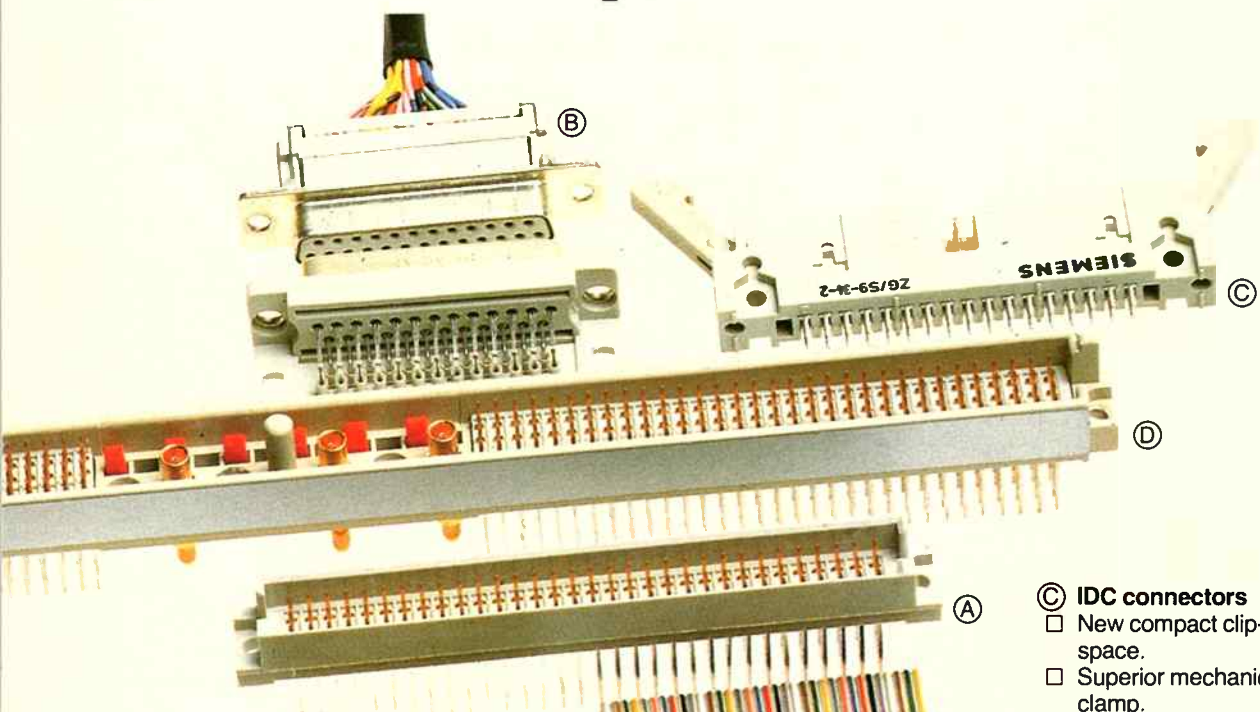

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