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Electronics Today INTERNATIONAL

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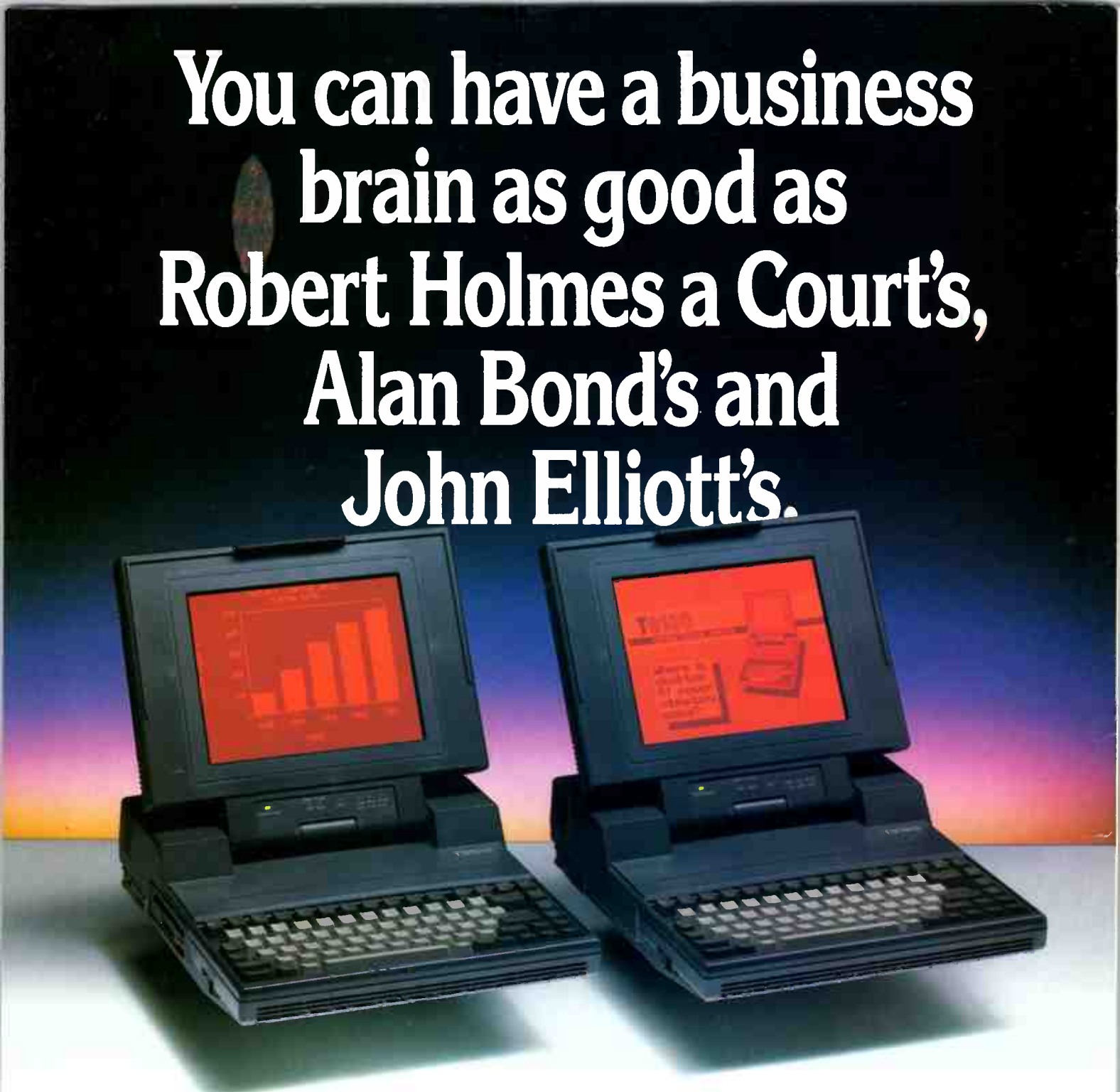

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MARCH 1987

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ADVERTISING INFO No. 3

Amstrad leads in UK

The newest addition to the Amstrad range of computers, the PC1512 (see ETI, February 1987), is now Britain's top-selling business micro. IBM has been the traditional leader in micro-saturated Britain, but Amstrad appears to have outsold them.

Figures released last week by the market research firm, Romtec, show that in December 1986, the first month in which the 1512 was widely available, Amstrad accounted for 26% of sales through dealers compared with IBM's 25%.

While this 25% is a fall of 13% from IBM's previous share of 38%, the company's unit sales have remained stable which indicates that Amstrad has increased the size of the total market with its new product.

Commenting on the news, Amstrad's Australian product manager John Chandler, said he was delighted with the figures but was not surprised to see the Amstrad doing so well.

"Computing power plays a very important role in maintaining a competitive edge in business today," he said. "We knew from our research that although many business people recognize this, the financial commitment involved in purchasing the necessary equipment quickly dampens their enthusiasm.

Mr Chandler says he is confident that sales of the 1512 in Australia will follow the same pattern as those in the UK.

"There has been tremendous interest in the 1512 since it was launched here in December last year," he said. "We have taken orders up to three months in advance."

When the Amstrad was released, it was the cheapest machine on the market, which helped it to move rapidly to a dominant position. Recent cost cutting by other distributors may well prevent Amstrad getting the market share here that it enjoys in the UK.

Telecom to charge bulletin boards

Telecom is currently formulating plans to begin time charging local calls. Under the new proposals, users on bulletin boards and other data services will be forced to pay for the length of time they use a connection. According to senior Telecom sources, there is no plan to extend the new policy to voice traffic, although this "is always under review".

Currently in Australia there is only one single fixed charge for a local call. Talk for five seconds or five hours and it still costs 18 cents. Recent studies at Telecom exchanges have shown that the average length of a voice call on the local network is 3.25 minutes, limited by "social" factors. The connection price reflects the costs of using the network for this period of time. However, network planners are concerned that no such constraint exists with data calls. There is nothing to stop people maintaining a connection for hours or even days. In fact, users browsing through bulletin boards have quite an incentive to maintain their calls for a considerable period of time.

Telecom is concerned because if current practices are allowed to continue, they may threaten the principles that currently determine the size of the network. Network planners use statistical analysis to estimate the maximum demand that will occur in the catchment area of an exchange during its busiest period. They then ensure that the exchange can just meet this demand. However, if the statistical length of calls increases, the number of cir-

cuits required to meet this maximum demand will also increase, along with the cost of providing the service.

Telecom engineers have been studying methods by which long duration data calls might be stopped, or alternatively, methods of charging such callers to ensure that they pay in proportion to their use of the network. Equipment does exist which would allow staff in exchanges to determine whether a particular circuit was being used for voice or data. However, policing such a system would be an administrative nightmare.

The current favoured solution appears to be to identify all the databases in the country, and then to put special call recording equipment on their lines at the exchange. The database would then be charged for the time the call was connected. It is suggested that there would be a grace period of perhaps 10 minutes, before charging would start, and of course, the calling party would still be charged for a local call.

It is being suggested within Telecom that since most bulletin boards are running on a quasi-professional basis already, the bulletin boards would not find it difficult to pass on the charges to their customers. There would also be powerful incentives to users and systems operators (sysops) to use the bulletin boards more efficiently.

Sysops have reacted angrily to the proposals. Their argument is that while Telecom is trying to target business hours who might tie up databases, it is going to badly affect hobby users who use the bulletin boards as a source of pleasure. They claim it is doubtful whether non-business use of bulletin boards is likely to affect the network to nearly the extent that Telecom seems to fear. There is concern that if the charging scheme goes ahead, it will be the end of non-commercial bulletin boards. They point to the fact that no country with timed calls has a thriving amateur data comms industry.

Telecom is inviting industry representatives to meet engineers during the next few months to try and find solutions to the problems. They are inviting input from sysops and interested users. Anyone with a view on the matter should get in touch with Telecom Public Relations in the first instance.

Cellular phone service begins

Telecom's launch of the cellular telecommunication network in February not only introduced world-class mobile and portable communications, but also saw the entry into the Australian market of a range of Telecom endorsed mobile telephones and systems.

Although completely new to Australia, the cellular phone system seems certain to create the next car accessory boom.

The service is provided and maintained by Telecom and all equipment licensed for use must have a 35% Australia content.

For an outlay of $3300 to $6500, subscribers can install a car phone which, when the car is not in use, can automatically divert any calls to a pre-programmed number.

Telecom expects 10,000 units to be in use after the first year of operation and 200,000 within five years.

Five manufacturers have been licensed to make cellular phones here — Mitsubishi, Racal, Air International (Novotel), NEC and Audiovox (Toshiba).

Some units are permanently fixed in the car, others are portable. Audiovox, for example, markets two Toshiba designs both of which can be used outside the vehicle if required. They feature repertory dialling of 30 numbers for making calls at the touch of a button.

Mitsubishi's system provides the consumer with a choice of applications. As a completely transportable system it operates as a mobile phone which can be easily taken from a vehicle or boat for use as a full power portable, wherever the location. Purchase as a vehicle installation or portable unit is also available. The portable-only unit can be bought with either an ac adaptor/charger or cigarette lighter dc adaptor/charger, and units can be upgraded to a full transportable version at any time.

Call diversion, a network function, makes the feasibility of a mobile and portable phone even more effective. A number of Mitsubishi features and functions, including a "hands free" remote microphone, one-hundred number memory, last number recall, on-hook dialling, programmable lock, horn alert and call-time display, provide many benefits new to the ▶

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mobile and portable communications market.

The cellular system operates in the 800 MHz band and is based on a series of transmitters which transmit and receive calls within areas (or cells) varying in size from around 2 km to 12 km, depending on population density.

Each cell has a base station which provides its own transmitter control and performance monitoring.

Every cell in the local network is tied into a central computer or mobile service switching centre (MSSC). Here the calls are automatically processed, the caller identification made and the call tied-in to the public telephone network.

As a car moves out of one cell into another, the MSSC detects the fading signal and the next cell picks up the call with no perceptible interruption.

The cellular system was introduced in the USA four years ago and is now used extensively in several countries, including Britain. It has been under test in Australia since November 1986.

Sydney is the first with a cellular network. Melbourne started in March, Brisbane starts in June, Adelaide in September and Darwin and Hobart in September. Perth, Alice Springs and other centres join the system in 1989. By 1990, the network should be Australia-wide.

All mobile cellular phones will have a nine digit number with 018 the first three digits.

CONGRATULATIONS

Congratulations to C. M. Zahra, a very lucky ETI reader who won the Toshiba CD player contest which closed January 1987. Mr Zahra correctly answered the demanding questions, got the address right, and was fortunate enough to be picked out of the bucket first (metaphorically speaking). He's pictured here grabbing his prize off Norm Krieke from Toshiba and would have liked to say a few words but had too much listening to do.

CSIRO starts to pay its way

Recent announcements by the new CSIRO chief, Neville Wran, demonstrate that work that has been going on in the organization over the last 10 years is starting to pay off at last. In separate announcements last month, Wran indicated that CSIRO-designed robots will be used on Ford assembly lines in Victoria, that US Ford will be using CSIRO software to design its carburettors, and that CSIRO welding technology has earned more than $35,000 in export sales already this year.

Wran said CSIRO was playing an increasingly important role in the automotive industry. Evidence of this was its influence on a decision by Ford Australia to include Australian-made robots in its plant to build the new EA 26 Falcon.

"CSIRO's expertise in industrial computer programming was influential in persuading Ford to place a $6 million order for two flexible manufacturing systems, including 27 robots, with Australia's largest robot manufacturing company, Machine Dynamics," he said.

The contract is for the design, manufacture and installation of 22 gantry robots with auxiliary gripping, tooling and positioning devices, and is worth more than $5 million.

The project will take about 12 months to complete and the result will be two fully integrated production lines.

On one line, the robots will transfer door components for the 1988 Falcon and Fairlane range between robot spot welding stations, adhesive applications and a 200 tonne press.

On the other line, the Machine Dynamics robots will transfer front fender aprons during assembly and have the flexibility to process the left or right fender aprons individually or both simultaneously.

Mr Wran also announced that CSIRO's Division of Manufacturing Technology had been working closely with Ford Australia on the design of its new $60 million paint shop now nearing completion at Broadmeadows, and had contributed significantly to the cost-effectiveness of the original design before it went to tender.

Opening a new building for CSIRO's Division of Manufacturing Technology in the Melbourne suburb of Preston, Wran announced that the 1988 range of Ford cars in the US would have carburettor bodies diecast using Australian computer software marketed by the Melbourne company Moldflow.

The software, known under the trade name 'Metiflow', was invented and developed by CSIRO's Divison of Manufacturing Technology in close collaboration with Moldflow.

It has already been used to design diecasting tools for parts for Holden motors exported to Europe, and for transmission casings for the Nissan range of vehicles in Australia.

Also at the opening of the new building in Preston, Science Minister Barry Jones commented on the large sum expended on R&D for the America's Cup.

The sum of $50 million, he said, was 10 times the annual budget of the CSIRO Division of Manufacturing Technology, and not far short of $67 million, which is CSIRO's total expenditure on research for the manufacturing sector.

"In other words, one sporting syndicate is prepared to spend, on an uncertain quest for a sporting trophy, 10 times the annual budget of one of the Divisions that we are asking to make a significant contribution to the entire nation's economic recovery.

"I think that as a nation, we really must re-examine our priorities urgently. What we need to do is to link our national pride to scientific and technological achievement. If we could do that, we would still have much to boast about instead of being disappointed about the loss of an intrinsically almost worthless, silver mug."

Another speaker at the ceremony, Mr Peter Lawton, Executive Deputy Chairman of Siddons Industries, said a Siddons subsidiary, Welding Industries of Australia (WIA), had already achieved sales in excess of $3.5 million for the "Synchropulse" welder, developed in conjunction with the CSIRO Manufacturing Technology Divison.

The product has sold more than 700 units at $5000 each or more, and has been developed to the point where the company is prepared to sell in world markets. With no franchise lockouts, we are well on the way to developing markets in the USA, UK and New Zealand, as well as in Australia.

Additonal staff are being employed in our Adelaide factory, which is being expanded to cope with the new demand. We have two other projects under way with the Divison, and our Ramset division is discussing yet another collaborative research program."

Indian space program

Indian scientists are in preparation for two major space projects: the launch of the second generation augmented satellite launch vehicle (ASLV) from India itself and the Indian Remote Sensing Satellite (IRS) from the Soviet Union.

The five-stage, solid-propellant-based ASLV, planned for launch in late March from India's eastern missile range on Sriharikota Island, is designed to put a 150 kg spacecraft into a near-Earth orbit. The satellite will carry a payload for the study of gamma rays.

The launch of this rocket, an improved version of the first-generation SLV-3, was postponed from 1985 because of problems in the motor of the fourth stage.

During its second flight in 1988, ASLV will carry a joint Indian/West German payload for remote sensing with stereoscopic equipment. For the third ASLV flight, the Indian Space Research Organization (ISRO), in conjunction with the Council for Scientific and Industrial Research (CSIR), will develop a satellite payload to monitor the upper atmosphere.

IRS, to be launched from the Soviet Union, will be lifted into a polar orbit.

It will gather information on agriculture, forestry and minerals.

Meanwhile, Indian scientists have a number of other projects on the boil. They are keeping INSAT-1C, the domestic satellite ready for launch on Ariane. They are also developing a bi-propellant polar satellite launch vehicle (PSLV) and a liquid fuel geostationary launch vehicle (GSLV), both of which are expected to take off in the late 1980s or early 1990s.

Another crucial area in which Indian space engineers are working is in the recovery of rocket boosters. It is proposed to recover the first-stage booster of PSLV with parachutes. Current plans call for PSLV to consist of a core booster with 125 tonnes of solid fuel and an additional six strap-on boosters, each with nine tonnes of solid propellant.

Britain and Russia to cooperate on Mars mission

Roald Sagdeev, the head of the Russian Space Research Institute, was in the UK recently to tell British scientists about opportunities for cooperation on their Mars missions, planned for the mid 1990s.

None of the plans involve landing cosmonauts on the planet, but provide information for a manned mission around the turn of the century.

According to *New Scientist* magazine, which covers the British science scene, David Southwood, professor of physics at Imperial College, London, was one of a group of British scientists talking to the institute about Britain's plans for participation in some of the Soviet Union's space missions. He says that Sagdeev told them of two proposed trips to Mars, one in 1992 and another in 1996.

In 1992, the Soviet Union will send an orbiter, a balloon and a vehicle called a penetrator to Mars. The penetrator will hit the planet's surface at 100 metres per second, and, together with observations from the balloon, will provide the Space Research Institute with information for a landing on Mars in 1996. Engineers and scientists have not decided yet at what altitude the orbiter will circle Mars, nor what experiments the orbiter and balloon will perform. The mission might also be delayed until 1994.

The mission in 1996 will bring materials from Mars back to Earth. However, Sagdeev told the British group that because of fears of contamination, the collected material would be analyzed on the Soviet Union's space station before returning to the Earth's surface.

Proposals for British scientific packages to ride on the Russian vehicle are currently awaiting funding, which in turn may well depend on the attitude of the British Government to cooperative space ventures with the European community.

Cheap GaAs on the way

An industry team led by Westinghouse has received a $US1.3 m contract from the US Air Force to develop a technology that can significantly increase the production and lower the costs of coated gallium arsenide (GaAs) integrated circuit wafers.

GaAs wafers transmit electrical signals six times faster, handle higher frequencies and withstand higher temperatures than their more-common silicon counterparts.

Such high performance has assured these devices a role in the next generation of military systems, but to date their cost has been too high for most other uses.

Using metal organic chemical vapour deposition processes at a new laboratory in Pittsburg, the team will attempt a 20 fold increase in gallium wafer preparation, which involves coating sliced crystals of the semiconductor with an electronically active layer so that atoms of both crystal and coating are precisely aligned.

Such quality coatings, called epitaxial layers are essential to the successful fabrication of high speed integrated circuits from the wafers.

The coating process, metal organic chemical vapour deposition (MOCVD) takes its name from the gaseous compounds that are released into a reaction chamber to form layers of crystals on heated wafers. The compound is used to transport vapours of gallium and arsenic metals, and contain the organic elements carbon and hydrogen which decompose upon contact with the hot wafer to leave the metals deposited in epitaxial layers.

MODEM ADDENDUM

Feb ETI's modem buyer's guide priced the NICE MODEM 2 for $552. The correct prices are in fact $279 and $693 respectively, from Computer Haven, (02) 349-2366. To find the distributor nearest to you, phone NICE MODEM CO, ph (02) 869-8777 or (09) 321-6636. Also note that the guide was for 1200/75 and 300 band modems only.

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(ETI Nov '81) ETI 158

Cat K41580 ..... Normally $39.50

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Want to put on really professional slide show? This slide cross-fader can provide smooth dissolves from one projector to another, initiate slide changing automatically from an in-built variable timer, and synchronise slide changes to pre-recorded commentary or music on a tape recorder. All this at a cost far less than comparable commercial units. (EA Nov '81) 81SS11

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The RIE kit includes a superb printed and prepunched metal case and inside metal work, plus a gell battery! Unbeatable VALUE!

Cat K85900 ..... Normally $169

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15V DUAL POWER SUPPLY

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Cat. K45810 ..... **$34.95**

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This clever electronic mousetrap disposes of mice instantly and mercifully, without fail, and resets itself automatically. They'll never get away with the cheese again!

(ETI Aug '84) ETI 1524

Cat K55240 **$39.95**

RADIOTELETYPE CONVERTER FOR THE MICROBEE

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Cat K47330 **$19.95**

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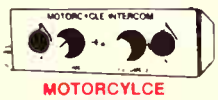
Add excitement to parties, card nights and discos with EAs Musicolor IV light show. This is the latest in the famous line of musicolors and it offers features such as four channel "color organ" plus four channel light chaser, front panel LED display, internal microphone, single sensitivity control plus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

(EA Aug '81) 81MC8

Cat K81080 **$99**



MOTORCYLCE INTERCOM

OVER 500 SOLD!

Motorcycling is fun, but the conversation between rider and passenger is usually just not possible. But build this intercom and you can converse with your passenger at any time while you are on the move. There are no "push-to-talk" buttons, adjustable volume and it's easy to build!

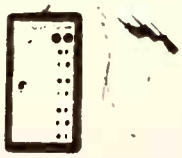
(EA Feb '84) 84MC2

Cat K84020 **$49.95**

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 **$39.50**



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 **$18.95**

12/240V 40W INVERTER

This 12 240V inverter can be used to power up mains appliances rated up to 40W, or to vary the speed of a turntable. As a bonus, it will also work backwards as a trickle charger to top up the battery when the power is on. (EA May '82) 82IV5

Cat K82050 **$69.95**

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 **$49.95**

AUDIO TEST UNIT

Just about everyone these days who has a stereo system also has a good cassette deck, but not many people are able to get the best performance from it. Our Audio Test Unit allows you to set your cassette recorder's bias for optimum frequency response for a given tape or alternatively, it allows you to find out which tape is best for your recorder. (81AO10) (EA Oct '81)

Cat K81101 **$59.50**

VIDEO FADER CIRCUIT

Add a touch of professionalism to your video movies with this simple Video Fader Circuit. It enables you to fade a scene to black (and back again) without loss of picture lock (sync) or colour.

(EA Jan '86, 85ff10)

Cat K86010 ..... Normally $24.95

Special, only $19.95

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**

PARALLEL PRINTER SWITCH KIT

Tired of plug swapping when ever you want to change from one printer to another? This low-cost project should suit you down to the ground. It lets you have two Centronics-type printers connected up permanently, so that you can select one or the other at the flick of a switch.

(ETI 666, Feb '85)

Cat K46660 **$79.95**

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)

Cal K80033 **$97.50**

HUMIDITY METER

This project can be built to give a readout of relative humidity either on a LED dot-mode display or a conventional meter. In addition it can be used with another project as a controller to turn on and off a water mist spray in a hothouse, for example. (ETI May '81) ETI-256 (Includes humidity sensor $19.50)

Cat K42560 **$49.95**

STEREO ENHANCER

The best thing about stereo is that it sounds good! The greatest stereo hi-fi system loses its magnificence if the effect is so narrow you can't hear it. This project lets you cheat on being cheated and creates an 'enhanced stereo effect' with a small unit which attaches to your amp. (ETI 1405, ETI, MAR 85)

Cat K54050 **$79.50**

THE BUSKER PORTABLE AMPLIFIER

This handy amplifier is completely portable and is capable of operating from either the mains or a 12V battery. Main features include guitar and high-level inputs, an inbuilt loudspeaker, and bass and treble controls. Its just the thing for busking or for guitar practice.

(EA Feb. 85 85ba2)

Cat K85020 (excluding cabinet)**$99**

DELUXE CAR BURGLAR ALARM

Stop your car from being one of the 70,000+ stolen cars stolen each year with this "state of the art" car burglar alarm. Features include key switch operation, delayed entry and exit, automatic reset, and provision for an auxiliary battery. Further more, of the 10 most important features listed by NRMA, this EA Deluxe Car Alarm has 9 of them!

(84ba5, EA May '84)

Cat. K84050 ..... **$99.50**

MODEL ENGINE IGNITION SYSTEM

Get sure starts every time, without glow plug burnouts on your model engines.

(ETI June'83) ETI 1516

Cat K55160 **$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 K84111 **$9.95**

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**

PREAMP FOR PAGING AMP

A versatile preamp with separate bass, treble and volume. (ETI 1421)

Cat K54210 **$24.95**

FAIR DINKUM RS232 FOR MICROBEE

The Microbee, among other home computers, has a 'sort of' RS232 port in that it doesn't implement negative-going portion of its ouput signal (TxD). Most peripherals with an RS232 input can cope with that, but inevitably, there are those that can't. This project fixes that.

(ETI 676, ETI FEB '84)

Cat K46760 **$39.50**

PH METER KIT

Build this pH meter for use with swimming pools to fish tanks to gardening, this pH meter has many applications around the home. This unit features a large 3 1/2 digit liquid crystal display and resolution to .01 pH units, making it suitable for use in the laboratory as well.

(EA Dec '82) 82PH12

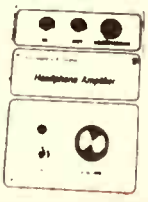
Cat. K82123 ..... **$199**

GENERAL PURPOSE AMPLIFIER CLASS B

One of the handiest 'tools' for the electronics experimenter is a genuine purpose audio amp. This module will work from a wide range of supply voltages, has good sensitivity, is robust and reliable - easy to build too! (ETI 453)

(ETI April '80)

Cat K44530 **$14.95**



HEADPHONE AMPLIFIER

PRACTICE WITHOUT ANNOYING THE FAMILY!

If you play any type of electronic instrument, this headphone amplifier will surely interest you. It will let you practice for hours without upsetting the household or you can use it to monitor your own instrument in the midst of a rowdy jam session. (EA Feb '84) 83MA11

Cat K84111 **$29.95**

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 **$26.95**

CUDLIPP CRICKET

A fascinating Electronic Cricket with just two ICs. The Cudlipp can be used to bug your home, office etc! Great fun! (EA Feb '82) 82EG2

Cat K82022 **$12.95**

PARABOLIC MICROPHONE

Build a low cost parabola, along with a high gain headphone amplifier to help when listening to those natural activities such as babbling brooks, singing birds or perhaps even more sinister noises. The current cost of componenets for this project is around $15 including sales tax, but not the cost of batteries or headphones. (EA Nov '83) 83MA11

Cat K83110 **$14.95**

SERIES 5000

INDIVIDUAL COMPONENTS TO MAKE UP A SUPERB HIFI SYSTEM!

By directly importing and a more technically orientated organisation, ROD IRVING ELECTRONICS can bring you these products at lower prices than their competitors. Enjoy the many other advantages of RIE Series 5000 kits such as "Superb Finish" front panels at no extra cost, top quality components supplied throughout. Over 1,500 sold!

For those who haven't the time and want a quality hi-fi, we also sell the Series 5000 kits assembled and tested.

POWER AMPLIFIER

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

- 1% Metal Film resistors
- [illegible]

SPECIAL, ONLY $399
SAVE $50

[illegible] and developed by [illegible] 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 continues -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 [illegible] PREAMPLIFIER

- 1% Metal Fi[illegible]

SPECIAL, ONLY $359
SAVE $40

[illegible] believe that dollar for [illegible] commercial unit available that sounds as [illegible]

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

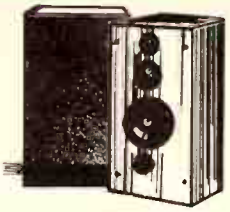
SPECIAL, ONLY $209
SAVE $30

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



VIFA/AEM 3 WAY SPEAKER KIT!

This superb 3 way speaker kit competes with systems that cost 2 - 3 times the cost of these units! (which may even be using VIFA drivers etc.) Never before has it been possible to get such exceptional value in kit speakers! Call in personally and compare for yourself!

The system comprises...
2 x D19 dome tweeters
2 x D75 dome midrange
2 x P25 woofers
2 x pre-built quality crossovers

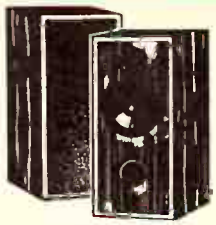
The cabinet kit consists of 2 knock-down boxes in beautiful black grain look with silver baffles, speaker cloth, innerbond, grill clips, speaker terminals, screws and ports

D19 DOME TWEETER SPEAKER 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 2ohms
Moving Mass: 0 2 grams
Weight: 0.28kg

D75 DOME MIDRANGE SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 350 - 5,000Hz
Free Air Resonance: 300Hz
Sensitivity (1W at 1m): 91dB
Nominal Power: 80 Watts (fo 500Hz, 12dB/oct)
Voice Coil Diameter: 75mm
Voice Coil Resistance: 7 2ohms
Moving Mass (incl. air): 3 6 grams
Weight: 0.65kg

P25 WOOFER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 25 - 3,000Hz
Free Air Resonance: 25Hz
Operating Power: 5 watts
Sensitivity (1W at 1m): 89dB
Nominal Power: 60 Watts
Music Power: 100 Watts
Voice Coil Diameter: 40mm
Voice Coil Resistance: 5 7ohms
Moving Mass (incl. air): 44 grams
Thiele/Small Parameters:
Qm 3 15
Qe 0 46
Qt 0 40
Vas 180 1
Weight: 1 95kg

Complete Kit Cat K16030 **$1,199**
Speaker Kit Cat K16031 **$949**
Cabinet Kit Cat K16032 **$349**



VIFA/AEM 2 WAY SPEAKER KIT!

This exciting new speaker kit, designed by David Tillbrook (a name synonymous with brilliant design and performance) uses VIFA's high perfomance drivers from Denmark. You will save around $800 when you hear what you get from this system when compared to something you buy off the shelf with similar characteristics. Call in personally and compare for yourself!

The system comprises...
2 x P21 Polycone 8" woofers
2 x D25T Ferrofluid cooled dome tweeters with Polymer diaphrams
2 pre-built quality crossovers

The cabinet kit consists of 2 knock-down boxes in beautiful black grain look with silver baffles, speaker cloth, innerbond, grill clips, speaker terminals, screws and ports

D25T SPEAKER SPECIFICATIONS
Nominal Impedance: 6 ohms
Frequency Range: 2 - 24kHz
Free Air Resonance: 1500Hz
Operating Power: 3 2 watts
Sensitivity (1W at 1m): 90dB
Nominal Power: 90 Watts
Voice Coil Diameter: 25mm
Air Gap Height: 2mm
Voice Coil Resistance: 4 7ohms
Moving Mass: 0 3 grams
Weight: 0.53kg

P21 WOOFER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 26 - 4,000Hz
Free Air Resonance: 33Hz
Operating Power: 2 5 watts
Sensitivity (1W at 1m): 92dB
Nominal Power: 60 Watts
Voice Coil Diameter: 40mm
Voice Coil Resistance: 5 8ohms
Moving Mass: 20 grams
Thiele/Small Parameters: Qm 2 4
Qe 0 41
Qt 0 35
Vas 80 1

Weight: 1.65kg

Complete Kit Cat K16020 **$799**
Speaker Kit Cat K16021 **$649**
Cabinet Kit Cat K16022 **$209**

NEW!! DIRECT IMPORT!!

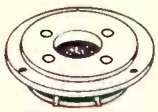
MULTI FUNCTION STEREO MIXER EQUALIZER

SPECIFICATIONS:
SENSITIVITY:
Phono: 3mV
Mic: 1mV
Line (tape or tuner): 150mV
SIGNAL/NOISE RATIO:
Phono: 55dB
Mic: 60dB
Line: 65dB
FREQUENCY:
Phono: 20Hz-20KHz (RIAA + 2dB)
Mic: 20Hz-20KHz + 3dB
Line: 20Hz-20KHz + 3dB
CHANNEL BALANCE: 0 5dB
T.H.D: Less than 0 03%
HEADPHONE IMPEDANCE: 4-16 ohms
OUTPUT: 0 775V
EQUALIZER:
Centre frequency: 60Hz, 250Hz, 1KHz, 4KHz 12KHz
Control Gain: + 12dB
POWER SOURCE: 110V/60Hz or 220V/50Hz

Cat.A12016 ..... Normally $399
SPECIAL, ONLY $349

PHILIPS SPEAKERS

Description	Cat.No.	Price
AD01610T8	(C12030)	$24.95
AD02160SQ8	(C12040)	$69.95
AD80652W8	(C12042)	$69.95
AD070620M8	(C12045)	$69.95
AD12250W8	(C12050)	$129.00



1" DOME TWEETER SPEAKER

Mylar diaphragm
SPECIFICATIONS:
Sensitivity: 96dB
Frequency Response: 2-20 kHz
Impedance: 8 ohms
Power RMS: 15 watts RMS
Magnet Weight: 5 4cz
Size: 96mm diameter

Cat C10234 ..... **$10.95**

2" HORN TWEETER SPEAKER

Mylar diaphragm, aluminium voice coil
SPECIFICATIONS:
Sensitivity: 95dB
Frequency Response: 1 5-20 kHz
Impedance: 8 ohms
Power RMS: 10 watts RMS
Magnet Weight: 2 5oz

Cat C10232 ..... **$8.95**

5" MIDRANGE SPEAKER

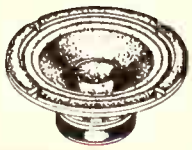
Sealed back, foam edge, black cone, silver dust cap
SPECIFICATIONS:
Sensitivity: 98dB
Frequency Response: 500-8 kHz
Impedance: 8 ohms
Power RMS: 10 watts RMS
Magnet Weight: 5 4oz

Cat C10230 ..... **$12.95**

6½" TWIN CONE FULL RANGE SPEAKER

Foam edge, black cone, black whizzer cone
SPECIFICATIONS:
Sensitivity: 89dB
Frequency Response: 60-15 kHz
Impedance: 8 ohms
Power RMS: 10 watts RMS
Magnet Weight: 5 3oz

Cat C10222 ..... **$14.95**



8" TWIN CONE FULL RANGE SPEAKER

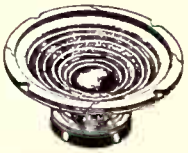
Foam edge, black cone, black whizzer cone
SPECIFICATIONS:
Sensitivity: 98dB
Frequency Response: 45-16 kHz
Impedance: 8 ohms
Power RMS: 30 watts RMS
Magnet Weight: 13oz

Cat C10224 ..... **$23.95**

8" WOOFER HIGH POWER SPEAKER

Cloth edge, dark grey cone, rubber mounting seal, cloth dust cap
SPECIFICATIONS:
Sensitivity: 90dB
Frequency Response: 60-4 kHz
Impedance: 8 ohms
Power RMS: 50 watts RMS
Magnet Weight: 20oz

Cat C10226 ..... **$34.95**



10" WOOFER HIGH POWER SPEAKER

Cloth edge, dark grey cone, rubber mounting seal, cloth dust cap
SPECIFICATIONS:
Sensitivity: 93dB
Frequency Response: 50-2.5 kHz
Impedance: 8 ohms
Power RMS: 100 watts RMS
Magnet Weight: 30oz

Cat C10228 ..... **$59.95**

12" WOOFER HIGH POWER SPEAKER

Cloth edge, dark grey cone, rubber mounting seal, cloth dust cap
SPECIFICATIONS:
Sensitivity: 97dB
Frequency Response: 28-4 kHz
Impedance: 8 ohms
Power RMS: 50 watts RMS
Magnet Weight: 30oz

Cat C10229 ..... **$69.95**

TOLL FREE MAIL ORDER NUMBER
008 33 5757
(STRICTLY ORDERS ONLY)
INQUIRIES TO (03) 543 7877

rie

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POSTAGE RATES

$1	$9 99	$2.00
$10	$24 99	$3.00
$25	$49 99	$4.00
$50	$99 99	$5.00
$100	$199	$7.50
$200	$499	$10.00
$500 plus		$12.50

FREE POSTAGE FOR ORDERS OVER $75 & UNDER 3KG!!

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

Certified Post for orders over $100 included free!
Registered Post for orders over $200 incuded free!

All sales tax exempt orders and wholesale inquiries to RITRONICS WHOLESALE 56 Renver Rd. Clayton Ph (03) 543 2166 (3 lines)

Errors and ommissions excepted

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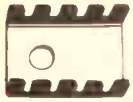


MINIATURE HEATSINK!

A great little fellow if you are short of space. Great price too, because we import direct so you save!

Cat H10606 1-9 $0.40 10+ $0.35

COMPUTER CABLE

CIC6 6 conductor computer interface cable. Colour coded with braided shield (to IE422 specifications). Copper conductor 6 x 7/0.16mm

1-9 metres $1.90/m — 10+ metres $1.70/m

CIC9.100 9 conductor computer interface cable. Colour coded with mylar shielding. 9 x 7/0.16mm

1-9 metres $2.50/m — 10+ metres $1.95/m

CIC12 12 conductor computer interface cable. Colour coded with mylar shielding. 12 x 7/0.16mm

1-9 metres $2.70/m — 10+ metres $2.50/m

CIC16 16 conductor computer interface cable. Colour coded with mylar shielding. 16 x 7/0.16mm

1-9 metres $3.90/m — 10+ metres $3.40/m

CIC25 25 conductor computer interface cable. Colour coded with mylar shielding. 25 x 7/0.16mm

1-9 metres $4.90/m — 10+ metres $4.40/m

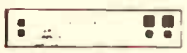
RAINBOW CABLE

Suitable for IDC connectors

Cat.No.	Description	$/metre
W12714	28AWG 14W	$1.80
W12716	28AWG 16W	$1.80
W12720	28AWG 20W	$2.20
W12726	28AWG 26W	$2.90
W12734	28AWG 34W	$3.60
W12740	28AWG 40W	$4.40

COUNTER

Cat $12.95



MAINS MUFFLER

Sudden mains disturbances can seriously affect your computer equipment and stored data. So why risk it when you can have a Mains Muffler, particularly when the cost of one failure is likely to be greater than the purchase price! So vanish those dangerous clicks and voltage spikes forever with the Mains Muffler!

SPECIFICATIONS:
Maximum total load 1000W 4 AMP 250V 50Hz
Outlet Sockets
Attenuation 150KHz - 47dB
500KHz - 68dB
10MHz 66dB
Dual T Section:
VDR Transient suppression
Surge capacity 200 Amp 8 x 20uS

2 WAY Cat X10089 $199
4 WAY Cat X10090 $299

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

105x30mm	Cat H10520	$ 3.50
105x75mm	Cat H10525	$ 3.50
105x100mm	Cat H10529	$ 4.90
105x140mm	Cat H10534	$ 6.50
105x150mm	Cat H10535	$ 6.75
105x170mm	Cat H10538	$ 7.95
105x195mm	Cat H10542	$ 9.90
105x200mm	Cat H10543	$ 9.90
105x225mm	Cat H10546	$10.50
105x300mm	Cat H10549	$12.00
105x600mm	Cat H10560	$24.95

SAVE $5

RS232 GENDER CHANGERS

- Saves modifying or replacing non-mating RS232 cables
- All 25 pins wired straight through

Cat X15650 Male to Male
Cat X15651 Male to Female
Cat X15652 Female to Female

Normally $19.95 each
Only $14.95

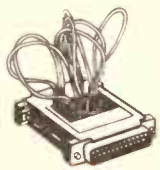
SAVE $8

RS232C NULL MODEM ADAPTOR

- Male to female connections
- Pins 2 and 3 reversed
- All 25 pins connected

Cat X15657 Male to Male
Cat X15658 Male to Female
Cat X15659 Female to Female

Normally $22.95
Only $14.95



RS232 WIRING ADAPTOR BOX

- Male to female
- 25 Detachable plug on leads
- 2 mini jumpers
- Ideal for experimenting or temporary connections

Cat X15665 Normally $39.95
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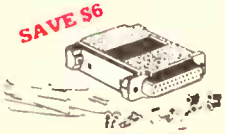

SAVE $6

RS232 MINI JUMPER PATCH BOXES

- Interface RS232 devices
- 25 pin inputs
- 25 leads with tinned end supplied
- Complete with instructions

Cat X15653 Male to Male
Cat X15654 Female to Male
Cat X15655 Female to Female

Normally $25.95
Only $19.95

SAVE $7

RS232 MINI TESTER

- Male to female connections
- All pin wired straight through
- Dual colour LED indicates activity and direction on 7 lines
- No batteries or power required

T D Transmit Data
D S R Data Set Ready
R D Receive Data
C D Carrier Detect
R T S Request to Send
D T R Data Terminal Ready
C T S Clear to Send

Cat X15656 Normally $39.95
Only $29.95

ANTISTATIC SOLDER SUCKER

- Light weight
- Sturdy construction
- Easy to remove tip
- Excellent value for money!

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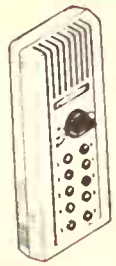

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Electronic control system with powerful in-built 100dB alarm. Changeable 3 digit, push button, secret code controller that is tamper proof. 3 function switch provides off position, chime and 7 seconds delay entry. Emergency panic button. Suitable for left or right hand door opening. Simple installation: no wiring required. Low current 15mA at 9V. Operates on 9V battery.

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CORDLESS RECHARGEABLE SOLDERING IRON

- Built in solder point illumination
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- Protective stand which also functions as charging unit
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- Plug pack power adaptor
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Cat T12480 Normally $79.95
SPECIAL, $69.95

FLUORESCENT WORK & EMERGENCY LIGHT

- Suits cars, boating, caravan, camping etc
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Cat A15052 $25.95

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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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MEL9501

Have you blown up your Apple drive by plugging it in backwards or not turning off the power while changing boards? We have the MEL9501 chip!

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Genuine Intel chips with manual and data sheets packed in boxes!

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PROGRAMMABLE 24 HOUR TIME SWITCH

- 48 switching possibilities per day
- 240V AC, 2400 watt, 10 amp
- Suitable for turning on Heaters/Coolers, pool filter, electric blankets, cooking appliances, waking you, even making the coffee! lights etc for security while you're away from home!
- Bargain Price!

Cat M22002 **only $19.95**

TV INTERFERENCE FILTER

Cuts CB Ham signals interference

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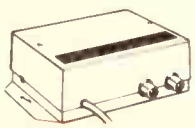
10dB IN-LINE COAXIAL AMPLIFIER

Reduces loss from splitters and long cable runs. Suitable for use with antennas, coaxial feed lines and VCR's. A.C. adaptor included.

SPECIFICATIONS:
Frequency Range: 5-900MHz
Gain: 10dB
Power Requirements: 12V A.C. Adaptor (included)
Input Impedance: 75 ohm
Output Impedance: 75 ohm

Cat L15043 $44.95



UHF/VHF/FM ANTENNA AMPLIFIER AND 2 WAY SPLITTER

Covers all Australian frequencies. Suitable for use in houses, caravans, boats etc

- 1 x 75 ohm input
- 2 x 75 ohm output
- Gain 2 x 6dB
- Maximum output 2 x 96dBuV

Cat L15041 $39.95

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
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- High UV intensity at chip surface ensures EPROMs are thoroughly erased
- Engineered to prevent UV exposure
- Dimensions 217 x 80 x 68mm

WITHOUT TIMER
Cat X14950 Normally $119
Special, $89

WITH BUILT-IN TIMER
Cat X14955 $139
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CAR ANTENNA BOOSTER

- In-line installation
- 12V boosts 100%

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NICADS!

Size	Desc.	1-9	10+	100+
AA	0.5 A.H.	$2.95	$2.75	$2.25
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UNIVERSAL BATTERY CHARGER AND TESTER

Save money on expensive batteries with this universal battery charger. Features include meter tester, and provisions for D, C, AA, AAA, N, button and cell batteries, 9V and 6V (square types). Comes complete with detailed instructions.

Cat M23533 $29.95

AEROSOLVE SPRAYPACKS

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Cat N11051 $5.95
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Cat N11057 $5.95
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The worlds best headphones are now available from Rod Irving Electronics!! 3 models to choose from, other models are available on request! (Phone Tony DiPaolo on (03) 543 2166)

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The HD40 is feather light, at just 60g! This HiFi stereo headphone is uncommonly convenient to use. Its systems can be rotated so it can fit into any drawer. It is also available as a TV headphone.

SPECIFICATIONS:
Frequency Range: 22 - 18,000Hz
Impedance: 600ohm
Distortion Factor: Approx 1.5%, pressure on ear, approx. 1.3 N
Weight: Approx. 60g
Length of lead: 3 metres

Cat A10515 $49.95

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White durable plastic, 8 ohms

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WA CAD/CAM centre

The State Government of WA, in co-operation with the McDonnell Douglas Corporation, has established a Manufacturing Technology Centre to boost the capabilities of local industry.

The centre will have an initial role in advancing the application of computer-aided design and computer-aided manufacture (CAD/CAM).

The Centre is located within the Department of Industrial Development.

Mr Mal Bryce, Deputy Premier and Minister for Industry and Technology said the Centre would create a long-term means of transferring selected manufacturing technology to local industry. "It will also place computer-aided design and manufacture within the reach of all Western Australian manufacturers.

"Commercial and technical productivity around the world is feeling the impact of CAD/CAM. Mr Bryce quoted the recent America's Cup series as an example of superior technology deciding the actual winner.

"It is essential for Western Australian manufacturers to keep up with the latest techniques that produce a competitive edge. Companies not using CAD/CAM within the next five years will be left behind."

Mr Bryce said the Centre would be managed by a McDonnell Douglas Corporation expert in advanced manufacturing technology, Mr Dennis Stajic.

Mr Stajic, is the former manager of CAD/CAM training for McDonnell Douglas and has spent the past 12 months establishing the Centre for Industrial Technology in Sydney.

The establishment of the Centre originated from offset commitments the McDonnell Douglas Corporation has with the Federal Government.

CSIRO buys supercomputer

The CSIRO has bought a Control Data 205 supercomputer for $3.7 million.

CSIRONET's 205. James Shaw checks an output.

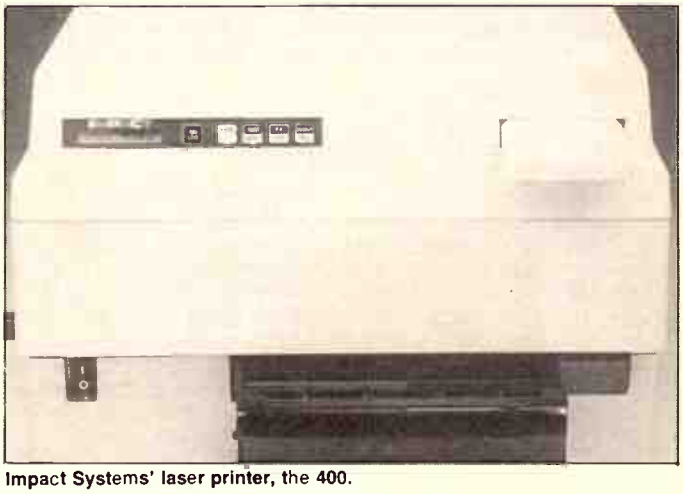
Announcing the deal, the Minister for Science, Barry Jones, said it was imperative that a supercomputer be available to Australian researchers and companies.

CSIRO's independent computing agency, CSIRONET, has been renting the machine for the past two years while its usefulness was being assessed. The purchase decision was taken because CSIRO will pay less to buy the computer than if it had continued with the lease agreement. The remaining 54 months of the lease would have cost about $US4.76 million.

"To ensure that the full potential of the Control Data 205 is realized, CSIRONET, CSIRO and the Department of Science are developing a national policy on supercomputing," said Barry Jones. "The aim of this policy will be to make the machine available as widely as possible to potential Australian users."

Negotiations were also underway to make the supercomputer available to university researchers on the same terms as CSIRO researchers.

Supercomputing had a shaky start in Australia in 1984 when CSIRO found there was little demand for the Control Data 205, Australia's first and only publicly available supercomputer. Usage has grown steadily as users in a wide range of high-technology fields become familiar with the machine's power and versatility. Today it is used primarily by CSIRO and university researchers, government departments such as the Bureau of Meteorology and, increasingly, private companies. To boost usage CSIRO provided access to the supercomputer at a nominal cost helping Australian researchers become familiar with the machine.



Impact Systems' laser printer, the 400.

Cash for Impact Systems

The venture capital company, SA Ventures, has invested $750,000 for a five per cent share in Impact Systems.

SA Ventures is a subsidiary of the Adelaide-based Enterprise Investments group and was listed with Stock Exchanges last December.

The stake in Impact Systems is the eighth investment by SA Ventures but its first since its public issue.

Impact Systems is primarily involved in the design, manufacture and distribution of laser computer printers.

Since being established in October 1983, turnover has gone from $1.1 million to almost $17 million in 1985/86. It's the only Australian manufacturer of laser printers, and commands a dominant share of the domestic market. It also has a marketing presence overseas and export sales are increasing via Impact offices in Amsterdam and San Francisco.

Milivoj Von Somogy was recently appointed President of SGS' Asia Pacific operations.

The SGS shuffle

The Italian semiconductor firm SGS has decided to spin off an an independent company, Innovative Silicon Technology SpA. SGS is transferring all its business responbility for application-specific ICs (ASICs), including all its customized products such as gate arrays, cell-based ICs and ICs designed using silicon compilation-type techniques.

According to SGS, the decision was taken in order to focus on those products important to the electronic equipment industry through a smaller more flexible operation. The move reflects the growing proportion of total semiconductor business being done by ASICs.

Meanwhile, in another shake-up, SGS has appointed Milivoj Von Somogy as President of its Asia Pacific operations. Von Somogy's career began in 1954 as a circuit design engineer in Europe. Moving to Asia Pacific in 1956, he held various design posts in Australia before accepting the post of Applications Manager for Fairchild Semiconductor in Hong Kong in 1965.

In 1967, he was appointed General Manager of Motorola, Hong Kong, where he worked until 1969 then was transferred back to Europe. He moved to SGS Semiconductor in 1981 to work as Corporate Vice President and Director of Strategic Planning at SGS' headquarters near Milan.

One of his major challenges will be to improve the corporation's performance in Australia, particularly with ASICs. In one move, SGS has joined with its distributor, RAE, to establish a sales and technical advisory service for the range of SGS semiconductors. The service operates from **178 Pacific Hwy, St Leonards, NSW 2065. (02) 438-5388.**

Coherent light record

AT&T Bell Laboratories researchers are claiming the highest transmissions rate for coherent lightwave systems, sending 2 Gbits for 170 kilometres without a repeater.

That's a record bit-rate-distance product for coherent systems, and a distance record for any system operating at two gigabits per second. The company also set the previous record for coherent systems at one gigabit per second for 200 kilometres in 1986.

"We've shown that coherent systems can operate at two gigabits by stretching available technology to its limit," said Alan Gnauck, a member of staff in the Lightwave Systems Research Department. "We now have to create more powerful lasers, better electronics and more sensitive detectors to transmit at higher bit rates without significant penalties."

Coherent systems step down incoming optical signals from optical to microwave frequencies, using superheterodyne techniques. The receiver adds light from a local oscillator laser to the incoming optical signal and produces an intermediate frequency from these two light streams. The intermediate frequency is sufficiently low so that signals can be processed efficiently by conventional electronic components. Coherent techniques and conventional electronics improve receiver sensitivity and wavelength selectivity as well because sharp electronic filters can be used.

Improvements in wavelength selectivity may one day permit hundreds, perhaps even thousands of channels, to be multiplexed, or combined, onto a single fibre. To date, the experimental record for multiplexing channels is 10.

Researchers used a buried hetero-structure, 1.5-micrometre wavelength injection laser, standard AT&T production fibre and a dual-detector balanced receiver to achieve the record results.

These achievements can be set beside AT&T Bell Laboratories' other startling record. The company reported a 1986 fourth-quarter loss of $US1170 million.

The Micromania board

Micromania, the computer sales outlet on Sydney's Parramatta Road, has started its own bulletin board service.

The service will be on-line 24 hours a day for six days and another half day per week. It will provide a comprehensive product and price catalogue, plus information on new products and also interesting topics of a technical nature from time to time.

A database of public domain software will be available for downloading by registered users of the service. There is no fee or subscription required to become a registered user. Registered users will be given 20 minutes on-line time at any one session which may be increased or decreased depending on the amount of traffic.

Micromania bulletin board service: (02)568-2196; Sysop: Maniac; Speed: 1200; Data bits: 8; Parity: none; Stop bits:1.

New Telecom fund to back Aust research

Telecom Australia has established a $5 million annual fund for the research and development of Australian telecommunications products.

Managing Director, Mr Mel Ward, said the fund was part of Telecom's continuing commitment to encourage local industry to develop and manufacture high-tech products. He said Telecom and the business community should look for innovative and 'Australian ways' of researching and introducing telecommunications products.

According to Managing Director Mel Ward, the new fund is "significant because it complements our current approach to Australian-based research and development. We do support industry through research and development contracts for specific Telecom initiated projects, but we are now prepared to make additional financial resources available to entrepreneurs who wish to develop ideas and concepts for products which can be used on the Australian telecommunications network and the world market.

"Telecom may wholly fund the future costs or partly fund them in retum for appropriate industrial property rights. Selected projects may also have the assistance of Telecom's engineering knowledge and facilities as development aids."

Mr Ward said he was confident the fund would gain widespread acceptance by the business community.

Enquiries and applications should be directed to **Mike Hannagan (03)606-5101 or Jeff Levers (03)606-6808 at the Telecom Technical Liaison Office, 3/172 William St, Melboume, Vic 3000.**

APRIL

Computer Network Security, a three day seminar presented by Donald W. Davies between 6-8 April at the Old Melbourne Hotel. Ph (02)498-7877, (008)22-6776 (interstate).

Les Bell will hold a **series of national seminars on Mastering PC-DOS/MS-DOS.** Adelaide 6-7 April, Brisbane 23-4 April. Ph (02)290-3555 (Sydney), (03)67-7117 (Melbourne), (09)324-1142 (Perth), or (008)22-4514.

Supporting Personal Computers a three day seminar given by Les Bell. Melbourne 1-3 April, Adelaide 8-10 April, Brisbane, 27-9 April, Perth 6-8 May. Ph Sydney (02)290-3555, Melbourne (03)67-7117, Perth (09)324-1142 or (008)22-4514.

Guide to the Unix Operating System presented by Greg Rose, Sydney 7-8 April, Melbourne 31 March-1 April. Ph Sydney (02)290-3555, Melbourne (03)67-7117, Perth (09)324-1142, or (008)22-4514.

The fourth workshop on small computer systems, organized by Queensland Institute of Technology, is on 13-15 April and calling for papers. Contact Dr C. Chesmond, QIT Dept of Elec Eng, on (07)223-2484.

Labex '87, international lab and equipment and products exhibition is on in Brisbane at the Science Pavilion, RNA Exhibition Grounds, 31 March to 2 April. Contact BPI on (02)266-9799.

ATUG '87 4th Australian Telecommunications Exhibition & Conference will be held at the Hilton Hotel in Sydney 7 to 9 April. Contact Riddell Exhibitions on (03) 429-6088.

Microelectronics Conference VLSI, Melbourne 8-10 April, will examine all aspects of the industry. Contact the Conference Manager, 11 National Circuit, Barton ACT 2600. Ph (062)73-3633.

The What's New in Electronics Exhibition — electronics in process control — will be held 14-15 April at the State Sports Centre, Underwood Rd, Homebush, NSW.

The 17th International Symposium on Industrial Robots will be held 26-30 April at the Chicago Hilton & Towers. Contact RI/SME Public Relations, 1 SME Dr, PO Box 930, Dearborn, MI 48121. Ph 313/271-0777.

MAY

Communications USA (telecommunications, radio and satellite equipment) in Sydney 11-15 May. Contact Ken MacKenzie on (02)264-7044.

Australian Software Engineering Conference — ASWEC 87 — is scheduled for 13-15 May at the Defence Force Academy, Canberra. Contact the Conference Secretary Commercial, Unit 3, 2 New Maclean Street, (PO Box 79) Edgecliff 2027. Ph (02)327-4822.

Ausgraph '87 is on 11-15 May in Perth. Contact Conference Secretariat on (03)387-9955.

In a **CAD/CAM Congress** at the Regent Hotel, Melbourne, 17-20 May, a panel of experts will discuss technical computing applications. Contact (03)51-9153.

Photographics '87, an exhibition of the equipment and technology of photographics will be held 23 to 26 May at the RAS Showgrounds in Sydney.

JUNE

Communications '87, the Australian International Office Technology Exhibition, is on 1 to 4 June at the Royal Exhibition Building, Melbourne. Contact Australian Exhibition Services on (03)267-4500.

PC87, The Ninth Australian Personal Computer Show is on 1 to 4 June at the Royal Exhibition Building, Melbourne. Contact Australian Exhibition Services on (03)267-4500.

Office Technology '87 will be held 1 to 4 June in Melbourne. Contact Australian Exhibition Services on (03)267-4500.

The **1987 Computing Systems Conference** will be held 17 to 19 June in Brisbane. Contact the Institute of Engineers, Australia, 11 National Circ., Barton, ACT 2600. (062) 73-3633.

Videotex '87 Exhibition & Conference is on in Melbourne over three days in June. Contact Riddell Exhibitions on (03) 429-6088.

The Australian Hi-fi Shows '87 will be held Sydney 19-21 June at the Airport Hilton; Brisbane 3-5 July at the Gold Coast International Hotel; Melbourne 17-19 July at the Dallas Brooks Hall; Adelaide 24-26 July at the Adelaide Hilton.

Videotex '87 to be held 30 June to 2 July at the Sheraton Hotel, Auckland. Contact the Secretariat on (649) 68-6955.

The Third National Space Engineering Symposium will be held 30 June to 2 July at the Australian Defence Academy in Canberra. Contact The Conference Manager on (062)73-3633.

JULY

Automach '87, an exposition on automated manufacturing and sponsored by the SME, is scheduled for 7 to 10 July in Sydney. Contact Adolph Greco on (02) 875-2377.

The 1987 Perth Electronics Show is on again at the Claremont Showgrounds, Perth from 29 July to 2 August. Contact address: 94 Hay St, Subiaco, WA 6008. (09)382-3122.

AUGUST

A symposium on signal processing and its applications will be held at the University of Qld 24-28 August. Those interested in participating contact the Conference Secretariat, ISSPA 87, Uniquest Ltd, University of Qld, St Lucia, Qld (07)377-2733.

ANZAAS Townsville Conference, 24-28 August. Examination of databases, communications and networks, videotext, etc. Contact G. Gupta, Department of Computer Science, James Cook University, Townsville, Qld 4811.

Nelcon '87 national electronics conference will be held 24-28 August at Auckland University, New Zealand. Contact B. S. Furby on (02)957-3017.

SEPTEMBER

IREECON '87 will feature digital technology when it is held 14 to 18 September at the Royal Agricultural Showground, Sydney. Contact Heather Harriman on (02)327-4822.

The 4th Australasian Remote Sensing Conference will be held 14-18 September at the Adelaide Convention Centre. Contact John Douglas, South Australian Centre for Remote Sensing on (08)260-0134.

Labex '87 international laboratory equipment and products exhibition is on 21 to 24 September at the Royal Exhibition Building, Melbourne. Contact BPI Exhibitions on (02) 266-9799 or (03)699-9151.

EXCIMER LASERS

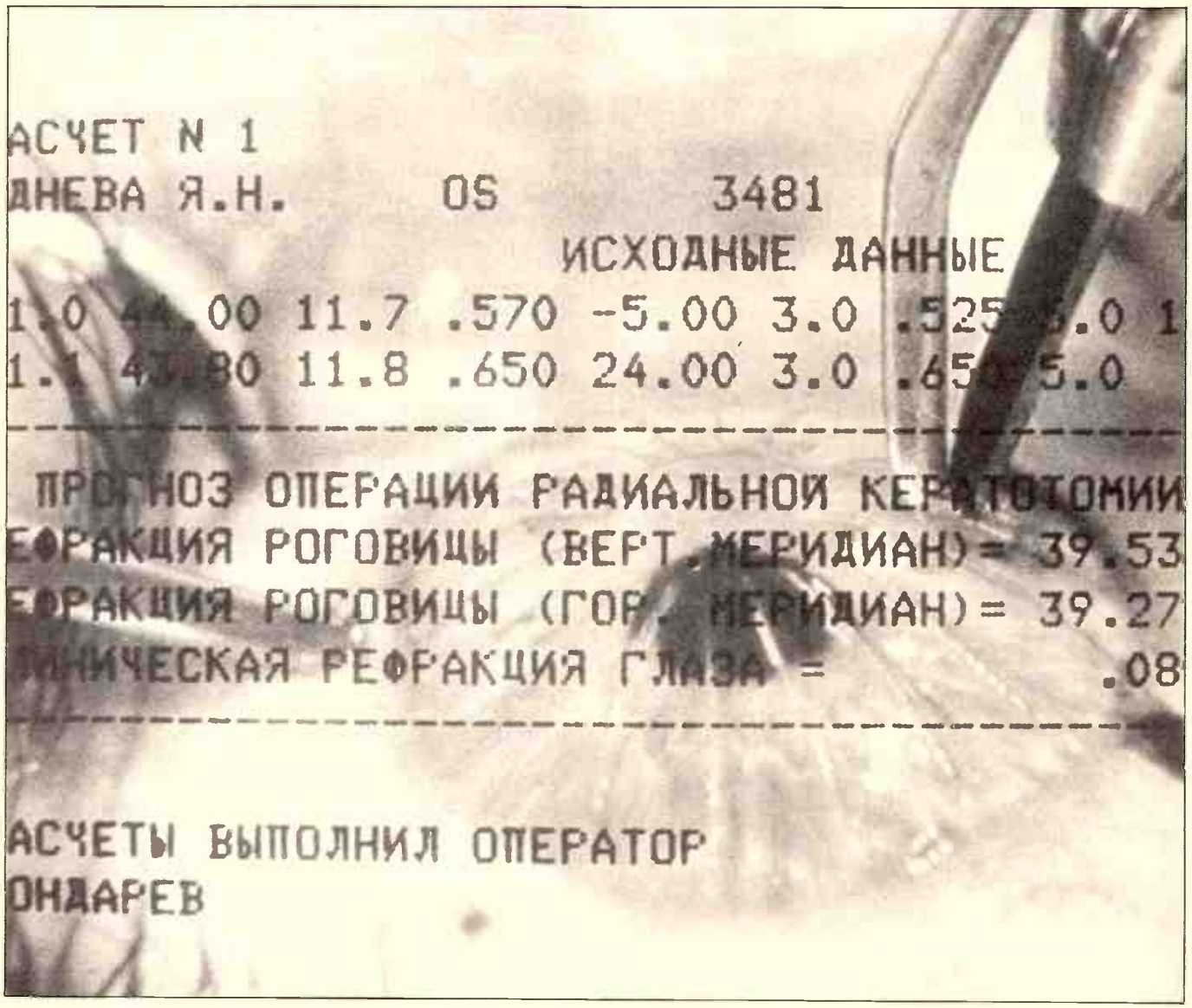
The biggest in the world is powerful enough to replace all our existing power stations for a nanosecond; the smallest could be used to cut open your eye. Excimer lasers will be one of the great tools of the twenty-first century.

Malcolm Gower

M.C. Gower is with the Laser Division of the Rutherford Appleton Laboratory, Chilton, Oxford, UK.

EXCIMER lasers produce extremely intense bursts of ultraviolet light. Their ability to do so is generating a great deal of interest in areas as diverse as chemical synthesis, defence, surgery, and semiconductor processing and chip manufacturing. The short-wavelength photons they produce have enough energy to break most of the chemical bonds that bind molecules together, thereby fragmenting or stimulating them to change their form. This ability to control the chemical state of matter and change it in a desirable and very selective way is at the heart of many of the most exciting applictions of excimer lasers.

The most common type of excimer laser uses molecularly diatomic rare-gas halides as the active species from which the laser



light is produced. In their common, unexcited form, atoms of the rare gases neon, argon, krypton and xenon are unreactive or inert and do not readily form molecules. But if an electron is knocked off an atom to ionize it, the atom can become extremely reactive and form molecules, particularly with negative halogen ions, which have an additional electron attached to them.

Rare-gas halide molecules are held together by electrostatic forces, similar to the way alkali halide (salt) molecules are formed.

Rare-gas halide molecules have a transient nature. With a lifetime of a few billionths of a second before spontaneously emitting ultraviolet photons and falling apart, they cannot be bought in a bottle but must be created in the laser vessel *in situ*. This is usually done by high voltage electrical discharges in gas mixtures of halogen-bearing molecules and rare-gas atoms. The unexcited rare-gas halide molecules which form the lower laser level are unstable, so at any instant there are very few of them in the laser vessel.

Nearly all the rare-gas halide molecules in the vessel are excited and have energy available for extraction as ultraviolet laser photons. The wavelength of the laser light is determined by the type of molecule created and can be selected simply by changing the gas mixture originally added to the laser tube, as shown in Table 1. The pulsed energies of the light obtainable from typical commercial excimer lasers are also listed. Such devices can produce pulsed bursts of light lasting approximately $2x10^{-8}$ second at up to 500 times a second.

Nuclear fusion

Much larger excimer lasers can be built in the laboratory. A KrF laser at the Los Alamos National Laboratory, USA, will soon be producing four terawatts ($4x10^{12}$ watts) of ultraviolet light. This power is several times more than the combined capacity of all the electricity generating stations in the world today, but the laser can produce it for only about $5x10^{-9}$ of a second. The aim of this extremely large laser is to be used eventually in a laser-driven nuclear fusion power plant for the relatively cheap pollution-free production of electricity. It is presently being used to study the nuclear fusion reactions produced when the focused laser light illuminates, heats and compresses to high density tiny glass microspheres containing deuterium and tritium gas.

To obtain more fusion energy from the pellets than is put in by the laser light, the plasma created should last for at least $2x0^{-8}$ second and have a temperature close to that on the Sun (10^8 degrees), while maintaining a density more than 50 times that of solids. Experiments have shown that such high temperatures and densities are more readily achieved by using short-wavelength ultraviolet laser light to irradiate and compress the target. Because excimer lasers can efficiently convert electricity to pulsed bursts of ultraviolet photons (conversion efficiencies of over 10 per cent have been demonstrated) and can in principle do so many times per second, they are considered to be the most likely driver source for any laser-induced fusion power plant which may eventually be constructed.

Ultraviolet laser light spreads out much less when travelling over large distances than does longer-wavelength visible and infrared light, so such high-energy excimer lasers are also of interest as Earth-based directed-energy beam weapons for defence.

Semiconductors

The ability of ultraviolet excimer laser light to break molecules apart so easily is now being exploited in the semiconductor industry. For example, highly uniform conductive metal coatings can be deposited on the component surfaces of a silicon chip by using the laser to release metal atoms from gaseous molecules above the surface. This step in silicon chip fabrication is called chemical vapour deposition and is conventionally done by means of plasma techniques which, in general, are far more destructive to the silicon wafer and less controllable than the laser technique. Thin crystalline layers of silicon can also be grown by depositing atoms of silicon. Furthermore, by simultaneously locally melting the silicon wafer with an excimer laser, the technique can be adapted to implant dopants into the bulk silicon. Such implantation is used to create the p or n junctions which combine to form the miniscule circuit elements in the chip.

Present non-laser methods of implanting dopants into silicon by ion bombardment in plasmas tend to leave the silicon crystal lattice damaged, so it is essential to recrystallize (anneal) the silicon wafer in a high-temperature area. Apart from adding another slow step to the production process, high-temperature annealing of the whole wafer can also lead to distortions of the circuit elements on the chips. On the other hand, the excimer laser method of implanting can simultaneously locally anneal the silicon wafer as well as achieve very high, supersaturated concentrations of dopant atoms.

There is another process, too, in producing silicon chips that can be improved upon by the excimer laser. Extremely small complicated circuit patterns to be fabricated on the silicon wafer are initially drawn on by reproducing master mask patterns of the circuit. The mask patterns are laid over a thin, light-sensitive plastic polymer film called the photoresist, coated onto the silicon. In a way similar to that in which a camera works, lenses or mirrors project an image of the illuminated mask onto the photoresist. In the exposed, bright regions of the mask pattern, the photoresist is then removed by chemical development. Ions are subsequently implanted into the silicon through the gaps in the photoresist. This process of optical replication of mask patterns onto the silicon wafers is known as photolithography; incoherent lamp sources illuminate the mask.

Recently, however, ultraviolet excimer laser light sources have demonstrated several unique advantages over lamps in such work. The most striking advantage is that the laser can produce images which are nearly 10^9 times brighter than those produced by a lamp. This means that the exposure time of the photoresist can be made negligibly small, allowing a substantial increase in the chip throughput of a photolithography machine. Furthermore, because the wavelengths produced by excimer lasers are in general shorter than those produced by high-powered lamps, smaller feature sizes on the mask can be replicated on the chip. This allows many more, smaller circuits to be packed onto the chip, so that each chip can perform a greater number of operations at a greater ▶ speed.

TABLE 1.

	Wavelength (nm	Energy/ Pulse (mJ)
F_2	157	40
ArF	193	500
KrF	249	1000
XeF	351 353	500
KrCl	222	100
XeCl	308	500

The wavelength of light produced by an excimer laser depends upon the type of molecule created. It can be selected simply by changing the gas mixture originally added to the laser tube, as in the left hand column. In the right hand column are the pulsed energies of the light obtainable from typical commercial excimer lasers.

EXCIMER LASERS

Another advantage of the excimer laser is that the extremely short burst of ultraviolet photons can also directly remove (etch or ablate) the photoresist from the exposed regions without the need for wet chemical development. So the excimer laser source may mean cutting out another processing step in chip production.

Clean etching

Ultraviolet excimer laser light directly etches plastics materials by producing a micro-explosion through efficient, rapid breaking of the chemical bonds that hold the polymer together. Unlike lasers working at longer wavelengths, the excimer laser produces no melting and very little heating of the surrounding unexposed material. Remarkably steep clean-walled cuts are produced in the crater left behind. This type of clean etching also applies to biological tissue. The possibility of performing extremely clean cuts without charring and damage to surrounding tissue has aroused a great deal of interest in medical centres around the world.

The first study of a medical application of excimer lasers was to do with cutting and reshaping cornea tissue in the eye. Unlike light of a longer wavelength, ultraviolet radiation does not pass through the cornea layer at the front of the eye. In an operation known as radical keratotomy, pioneered in the Soviet Union, a diamond knife is used to make radial incisions in the cornea. Because the cornea as well as the lens can focus light, a change in its radius of curvature can lead to a permanent correction of defects caused by the lens, such as short sightedness. It has recently been shown that masking techniques enable this type of surgery to be done by means of an excimer laser, with a quality and precision far exceeding that achieved with a knife. Moreover, the laser can reshape the cornea by machining rings and crescent shapes. It can also make the precise incisions necessary for subsequent corneal transplants or removal of cataracts.

Balloon angioplasty

Work is also going on to investigate the use of the excimer laser to unblock arteries, a procedure known as angioplasty. Blockage near the heart by accumulation of plaque, the condition known as atherosclerosis, eventually leads to a heart attack. Most widespread of surgical methods now used to alleviate this condition is extremely invasive open-heart surgery, in which surgeons bypass the blockage by grafting a new artery around it. Less invasive is a recently developed technique called balloon angioplasty, in which a fibre is threaded through the arteries to the blockage and a balloon on the end is then inflated to open it out; the patient remains conscious throughout. But the technique can also damage arterial tissue. An alternative method might be to use light from an excimer laser, passed down through an optical fibre in the artery, to burn through the blockage cleanly. Initial studies have shown that for soft, non-calcified plaque the excimer laser can remove the constriction efficiently and cleanly. Calcified blockages are much more difficult to remove.

Among other medical applications being studied are very precise neurosurgical cutting in the brain and spinal column. Most applications of high-power visible and infrared lasers use the laser merely as a sophisticated cutting and welding torch. However, the most exciting potential applications of excimer lasers make use of the high powers which they are capable of producing and the ability of the ultraviolet photons to induce changes in the chemical state of matter in a most efficient way. Many new applications of excimer lasers may be expected to develop as scientists and engineers become increasingly aware of their tremendous potential. ●

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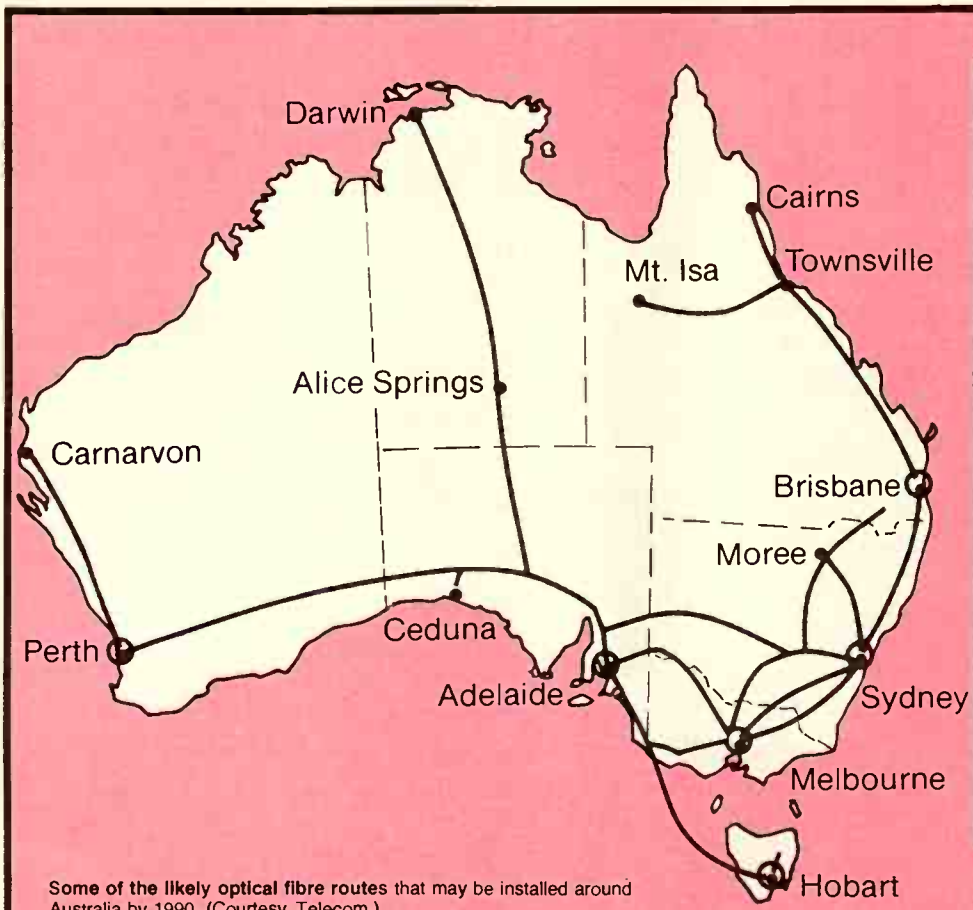
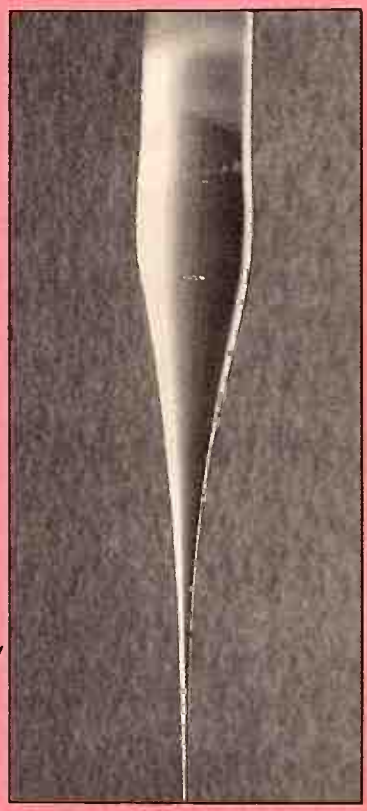


Some of the likely optical fibre routes that may be installed around Australia by 1990. (Courtesy Telecom.)



A 125 μm diameter optical fibre is drawn from preforms manufactured at Optix Australia's Melbourne factory.

TOWARDS AN ALL-FIBRE NETWORK

An update on progress of changing the telephone network from copper to glass.

N. R. Crane

N.R. Crane is from the Network Engineering Department, Telecom, Melbourne.

Australia's transmission network is a dynamic mix of cable and radio systems. It is continually being expanded and upgraded to meet the telecommunications need of the community. Currently, the digital transmission capacity of the network is being substantially augmented to provide for increasing data traffic and for network development leading to an integrated digital network and an integrated services digital network.

Although the initial development was by pulse code modulation systems in the network and by digital radio systems in the long distance network, a rapidly increasing proportion of new digital transmission capacity is now being provided by optical fibre transmission systems.

Approximately $42.5m will be spent on the purchase of optical fibre cable and associated transmission equipment for the 1986-87 installation program, much of which will be purchased in Australia. There are, of course, very substantial benefits for the Australian economy in maximizing the proportion of Telecom's annual material purchase ($140m in 1986-87) placed with Australian industry. There are also important benefits for Telecom in purchasing locally. These may be summarized as:

- greater ability to influence designs to suit Australian conditions;

- additional expertise available in Australia for Telecom to draw on;
- less complex delivery arrangements; and
- shorter delivery lead times.

Fibre in the network

Until the early 1980s all trunk bearers in Australia were analogue, provided on open wire, pair cable, coaxial cable or by radio. The coaxial cable system capacity progressed from 1260 circuits in the 1960s to 3600 circuits by 1981. The later higher capacity coaxial cable systems required repeaters at 4.5 km spacing, which were located in manholes, power fed over the cable and subject to lightning damage. The line equipment was mostly supplied by STC, Siemens and NEC, with some local content.

The 1982 trial NEC optical junction systems were installed in metropolitan Brisbane, Melbourne and Sydney. These systems used multi-mode fibre and line equipment operating in the 850 nm region, at bit rates of 34 and 140 Mbits/s, with repeater spacing of typically 9 km. Equipment supervision and orderwire facilities were conveyed on metallic pairs within a hybrid cable. These early systems soon proved viable and have subsequently proven very reliable.

In 1982 the Melton-Ballarat 140 and 565 Mbits/s single-mode optical fibre (SMOF) field trial was initiated to prove the technology prior to embarking on a very extensive intercapital program. To avoid lightning damage, completely non-metallic cable was used. As a result, it was necessary to provide local power for repeaters and in-band transmission for order wire and supervision functions. The maximum repeater spacing considered possible was about 30 km. Events rapidly overtook the trial and in mid 1984 tenders were called for the Melbourne-Sydney SMOF system, for delivery from July 1986. The initially planned Melbourne-Sydney repeater spacing was about 27 km for both 140 and 565 Mbits/s systems. Better than predicted cable performance together with statistical design techniques has led to revised repeater spacings in excess of 50 km and 45 km respectively.

Further commissions have been made for the Darwin-Katherine 140 Mbits/s SMOF system and initial 140 Mbits/s bearers of the Sydney-Canberra portion of the Melbourne-Sydney route. The Darwin-Katherine system is one of the first remote systems in the world and incorporates some solar powered repeater sites.

Telecom is currently being supplied single-mode equipment as follows: 2-, 8- and 34-Mbits/s equipment locally developed by STC, 140-Mbits/s equipment locally developed by NEC and Siemens, 565 Mbits/s equipment locally adapted by Plessey and analogue TV equipment developed by Siemens. The degree of local development varies and is in response to tough specifications and unique facilities required for often harsh Australian conditions. Local content varies from about 50 per cent to 70 per cent and gross optical transmission equipment purchases (excluding cable) are around $18.5m per annum.

Telecom's first major installation in the customer access network (CAN) is the multi-mode optical fibre (MMOF) loop network installed in the Melbourne central business district. This $3m pilot project passes about 50 major business offices and establishes an optical fibre network which can be used to support a wide range of services. The initial application of the network will be to link a number of Telecom buildings, which are being equipped with local area networks. Video equipped links are being provided to the research laboratories at Clayton and the external plant laboratories at Maidstone. These arrangements will be used to test concepts and techniques and to demonstrate how the network can support new products.

> ***Telecom has gained technical and economical benefits from this competent and competitive industry, and was keen to see a similar industry established to supply optical fibre cable.***

A number of point-to-point cables have also been installed in the CAN to meet specific customer needs.

Development of supporting industries

Australia has a well developed metal cable industry that has proved over a long period that it is capable of providing Telecom's metal cable requirements at lower cost than overseas manufacturers. Telecom has gained technical and economic benefits from this competent and competitive industry, and was keen to see a similar industry established to supply optical fibre cable.

Telecom first became contractually involved in the development of the optical fibre industry in 1976. Then a contract was let to AWA to develop the chemical vapour deposition in-tube process, for the manufacture of solid-core step index optical fibre.

Since that time, as Telecom's interest in optical fibre cable systems has increased, industry has responded with an investment of approximately $43m in two fibre plants and three cable plants. All of these are world-class facilities and currently produce all the optical fibre cable purchased by Telecom. During this period the Australian cable industry was kept informed of Telecom's needs and expectations, through regular liaison meetings at the technical and management levels.

By 1978 Telecom's interest in optical fibre systems was beginning to gather pace and small quantities of step index MMOF cable were purchased from AWA and Dainichi Nippon for research purposes. This was followed in 1980 by the purchase from Sumitomo of 8 km of six-fibre graded index MMOF cable for the Clayton-Springvale research laboratories installation in suburban Melbourne.

As Telecom's plans became clearer, it was necessary to develop optical fibre cable designs suitable for use in Australia. Companies were invited to tender for this work and contracts were subsequently let to Austral Standard Cables (ASC) and Pirelli. One of the most important outcomes of this work was the adoption of the slotted core design by Telecom for external optical fibre cable. The contracts had the dual benefits of better defining Telecom's needs and improving local industry's ability to meet these requirements.

During 1982 four field trials were held. Cable totalling 1100 fibre-kilometre (Fkm) was purchased from Mitsui (Furakawa), ASC, Sumitomo and ASC respectively for these projects.

Cable for the Melton-Ballarat 140 and 565 Mbits/s field trial was installed in 1985. The 74 km of eight-fibre SMOF cable required for this project was supplied by local manufacturers ASC and Olex, using imported fibres cabled in local plants, and by Siemens. The Siemens cable was fully imported, of a different de-▶

sign, and included primarily to determine whether it had installation advantages compared with the slotted core design for direct burial.

In addition to regular liaison meetings, Telecom held a special industry briefing meeting in August 1984. The purpose of this meeting was to give early notice to industry of Telecom's requirements for the 30,000 Fkm Melbourne-Sydney SMOF project. Installation is currently well advanced on this project and it is due to be commissioned in January 1988, as a bicentennial project.

Until 1986, practically all cable supplied to Telecom by Australian manufacturers used fibre obtained from overseas. During this year two Australian fibre plants came on stream and a rapidly increasing proportion of cable supplied to Telecom has contained fibre produced in Australia. Currently all the cable being supplied to Telecom is from the Australian cable industry using fibre produced in Australia.

In 1986-87, Telecom will purchase approximately 40,000 Fkm of optical fibre cable at a cost of $24m. It will be installed on major intercapital routes, on a very large number of smaller rural and metropolitan inter-exchange routes and for radio tail systems.

This cable will be produced by ASC at its Clayton (Vic) plant, Olex at its Tottenham (Victoria) plant and Pirelli at its Dee Why (NSW) plant. The fibre requirement is now being provided by Optix from its Tottenham (Victoria) plant using Sumitomo technology, and by Optical Waveguides Australia (OWA) from its Noble Park (Victoria) plant using Corning technology.

Future trends and developments

Single-mode optical fibre will have a prominent role in the expansion of Telecom's digital transmission network for many years. Extensive use in the junction and trunk inter-exchange networks will continue and use in the CAN is expected to grow.

In the near future, there is the possibility of even longer repeater spacings for long haul systems by utilizing the 1550 nm window and Telecom is already negotiating on this. By the mid 1990s, expansion of the intercapital network will probably be by 2.4 Gbit/s systems (30,720 VF circuits) using existing cable and repeater spacings. Thereafter, emerging heterodyne techniques may allow repeaterless operation for hundreds of kilometres, coupled with significantly greater capacity, further reducing the cost of long distance systems.

Perhaps the most exciting prospects in terms of manufacturing volume will be in the CAN, where virtually unlimited bandwidth can be made available to customers for telephone, video telephony, subscription TV, high definition TV and all manner of data transaction purposes.

This aspect is being examined in the pilot MMOF network in the Melbourne CBD. It is also proposed to test the use of SMOF in the CAN, with a pilot installation commencing in 1987 in the Sydney CBD.

Cost studies have indicated that by the early 1990s optical fibre cable systems could become an economically attractive alternative to the use of copper pairs in the residential CAN, particularly for enhanced services, basic access and primary rate ISDN services. The extent to which optical fibre is used in the CAN will be heavily dependent on the cost of associated opto-electronic devices. ●

Acknowledgement is made of the permission of the Chief General Manager, Telecom Australia, to publish this paper, and the assistance of Messrs R. Lewis, J. Clark and L. Vaux in the preparation of the paper is acknowledged.

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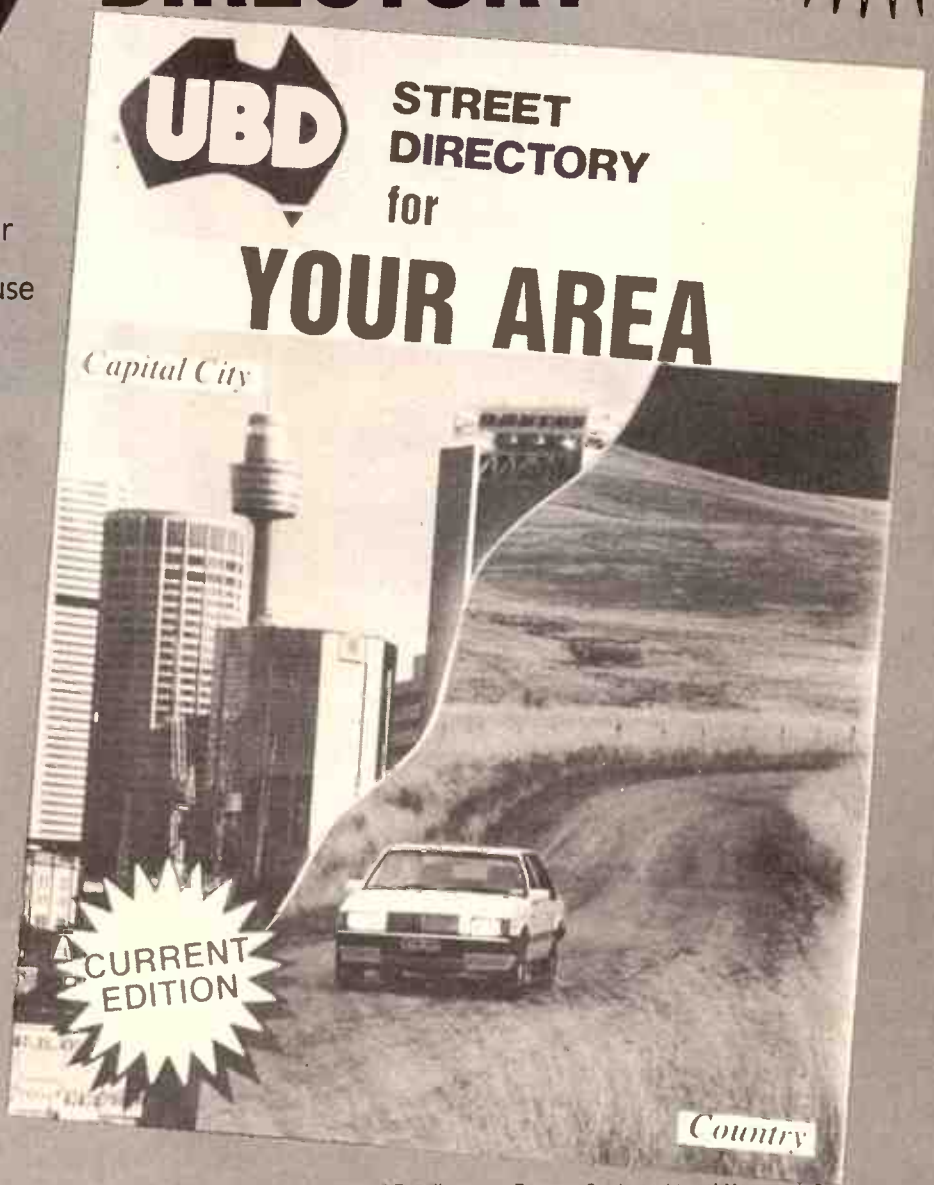

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COMPUTER MUSIC WITHOUT SPEAKERS

Computer music means sound reproduced through loudspeakers, right? Not necessarily. This article describes a system in which the computer plays the piano — dynamics and all. A commercial package possible? Maybe . . .

It is refreshing to attend a live musical performance that uses no artificial amplification. The ability of a performer to fill a hall with sound is always enthralling, as huge crowds at live performances continue to demonstrate.

However, electronics never quite seem to match the ambience of the performance. The compact disc and other innovations have elevated the quality of sound reproduction to new heights, but the difference between the live sound and the recording still remains. Indeed, one wonders whether a system that relies on loudspeakers could ever replace the ambience of the real instrument.

In the good old days

Since the beginning of the recording industry, such ruminations have led people to look at using the piano itself as the reproducing medium. The earliest attempt at a mechanical piano was the pianola, which used a long role of paper to control the keys of a piano. The paper had holes punched in it and was drawn over a pneumatic sensor which detected the presence or absence of these holes. Whenever one was detected a note was played; which note depended on the position of the hole.

During the 1920s, the well-to-do had access to a system that is now only pursued by collectors and enthusiasts. This system was the reproducing piano, a form of player piano that used a complex vacuum operated mechanism that not only played the notes but supplied all the dynamics of the original performance. Today, some of these instruments are still operating after careful restoration by their owners. It is not generally appreciated that the reproduction from these instruments can be incredibly good.

Inspired by these instruments, in 1976 I commenced the development and perfection of a system that married a self-playing piano and electronics. The result, now, is a successful interfacing of a computer and a piano, and a commercial package would appear a likely outcome.

I believe it is economically viable to produce a computer-controlled mechanism that sits before a piano keyboard with capabilities that would satisfy the most critical listener. I also suggest that a market for such a device exists. Given that many homes have the two pre-requisites, a piano and a computer, it becomes a matter of developing the missing link. If the device is truly effective, concise and rela-

tively cheap, then the conventional piano can once again become a source of entertainment with current technology providing the sophistication demanded by today's listeners.

The practicalities

In attempting to make a state-of-the-art computer-operated piano, several problems need to be addressed. The type of mechanism to 'play' the piano is foremost.

Keyboard instruments such as the piano or organ lend themselves to a mechanism that replaces human fingers. Fairly successful mechanical violins were once produced, and with ingenuity it is probable any instrument could be similarly adapted. However, the piano is probably the most suitable, as a player mechanism basically entails a means of providing a variable velocity force to each key. Solenoid-operated systems have previously been marketed; an example is the SuperScope tape-recorder-operated system developed by the Marantz Co in the early 1980s. A more sophisticated, though non-commercial system was developed about the same time by electronics engineer Wayne Stahnke in America. Working for the San Sylmar Museum in California, Stahnke developed a computer-based mechanism that controlled the velocity of each key's actuating solenoid. The final result, according to listener's accounts, is superb but the total cost (development and construction) was enormous. This instrument is capable of replaying performances exactly as recorded, but the player mechanism and associated electronics are relatively cumbersome. The SuperScope system, while cheap at around $2000, failed to deliver all the nuances and power of a virtuoso performance. The lack of sophistication prevented its ultimate success, although many were sold around the world.

Pneumatic versus electrical power

While an electrically powered instrument may seem most appropriate in these electronic times, the advantages of a vacuum powered system are many. Foremost is the similarity of a pneumatic to a human finger in its manner of striking a piano key. A pianist will hit each key with an initial force that quickly reduces; the exact opposite to the operation of a solenoid. Placing a capacitor in series with a solenoid gives an electronic approximation to this but multiply this 88 times, and the cost and bulk become limiting. Another often underestimated factor is the total power required. A concert pianist can generate up to 1 kW of instantaneous energy at the keyboard, and if the reproducing mechanism can't match this, the performance quality is compromised. A vacuum system with suitable reservoirs can provide this power easily.

Finally comes size, weight and cost of the mechanism. Given mass production techniques, and using traditional materials, the vacuum system offers many advantages.

Assuming the use of a vacuum powered system, the next problem is how to control the force applied to each pneumatic when re-creating the dynamics. A lesson can be learnt from the original reproducing pianos by studying the method they employed to such great success. The regulating systems differed between brands, but they all ultimately performed the same task. In principle, the player mechanism, called a 'stack', had some 88 individual key-actuating pneumatic bellows mounted on a ducting system supplied via two vacuum regulators. A valve to switch each pneumatic was incorporated within the unit that connected either regulated vacuum or atmosphere to the pneumatic as dictated by the piano roll.

> ***In 1978, leading enthusiast of the reproducing piano Dennis Condon and I developed an electro/ pneumatic vacuum regulator for use in a piano playing 'machine' that featured in many concert performances in Australia and New Zealand. Audiences heard the Grieg Piano Concerto performed with a full symphony orchestra.***

Dynamic control was achieved by dividing the stack at approximately the centre of the keyboard, and applying, via a regulator for each side, a controlled vacuum. Controlling the vacuum was achieved by a variety of complex methods, the basic principle being the introduction of a restriction in the vacuum supply line to each side. This implies that all notes played together within one or other side of the stack receive the same vacuum but, as later explained, careful coding can allow one or more notes to appear louder within the group.

The next aspect concerns the integration of electronics into a vacuum system. Many pneumatic control systems in industry do this to a high degree of sophistication. Making an electrical signal operate a pneumatic was also commonplace in the 1920s. In 1978, leading enthusiast of the reproducing piano Denis Condon and I developed an electro/pneumatic vacuum regulator for use in a piano playing 'machine' that featured in many concert performances in Australia and New Zealand. Audiences heard the Grieg Piano Concerto performed with a full symphony orchestra, and a recording was subsequently issued worldwide to excellent reviews.

Other recordings were later released, including the Tschaikovsky Piano Concerto (No. 1) and many solo piano pieces, all from reproducing piano rolls made by Percy Grainger. That this machine was capable of providing comparable performances to that of a live virtuoso indicates what we can expect.

The computer

So, we felt that on the basis of developments in the 1920s, a machine to operate the piano would be the least of our problems. Using a computer to provide the information that recreates the recorded performance is similarly relatively easy. (This blasé comment is made in hindsight after many years of development!) At this stage, I have written all the programs necessary to store reproducing piano rolls as digital information in an Apple computer, and then have the computer operate an original Ampico reproducing piano as if it were playing from the roll. Some interesting statistics come out of this endeavour, and are worth relating. Devotees to the IBM genre are perhaps curious why an 8-bit machine was used. Basically, 16-bit personal computers were not around when the project was commenced, but the final success has testified to the power of 8-bit computers, and adapting a 16 'bitter' is probably overkill.

In principle the system works to the following parameters. The roll, which could also be a piano keyboard, is 'looked at' by the recording system 50 times a second. Ninety-eight individual functions make up one scan, including all notes, pedals and the expression system. The resulting serial data stream, therefore, comprises around 100 individual binary bits; one for each function, the remainder for synchronizing purposes. This gives a pulse repetition rate that equates approximately to a 5 kHz▶

square wave. This frequency was established originally as the highest rate a cassette tape recorder could handle, as the genesis of the system was based on a cassette being a replacement for the piano roll. As a computer can handle higher input/output rates, the number of 'scans' per second could be subsequently increased if compatibility with an existing system was not a criterion. To enable the large amount of data to be economically stored, the computer program was designed to initially 'squeeze' the zeros to a more compact form as the majority of the scan incorporates those notes not being played. However, further processing of the data was needed if realistic RAM usage versus playing time was to be realized.

The subsequent processing, performed by an additional program, requires that each data 'word' comprising the 100 bits, be compared to the next word. The end result is that only the differences between the words are retained, and the replay program reconstitutes the data as it is played. The final figures average out to 16K of RAM providing about three minutes of music. This varies tremendously with the nature of the performance, as slow pieces have fewer changes between subsequent words (or scans), compared to faster performances. This means that most items of the repertoire require less than the 40K of RAM available on the Apple. For selections requiring more memory, such as a complete concerto, an extension memory card is used, available for peanuts on an Apple IIe anyway.

To maximize RAM availability in the Apple, and to create the highest possible disk storage space, a simplified DOS that features high speed data transfer was developed. A 64K Apple is required, and all programs are stored in the upper 16K normally occupied by BASIC. It transpires that for a typical Apple 40 track drive, a 5¼" diskette can provide an average of 40 minutes of music per side, and as two drives are used, over an hour or so playing time results from a maximum choice of 24 items at any one time.

Interfacing to a piano

The current standard for electronic musical instruments is the MIDI interface. It was developed as a means of information transfer between a wide range of electronic devices, including computers and electronic keyboard instruments. Its suitability as an interface for the system under discussion is not in question, but the MIDI convention is more complex than needed. The interface developed by me (in pre-MIDI days) uses a much simpler data format, where one binary bit is one note, a word is 100 bits, and an expression for one word encompasses all notes within that word. Also, the stored data is formatted to occupy minimal memory and disk storage space. However, if compatibility to the MIDI standard was necessary, a driver program to take the data and rearrange it to suit could be used.

Like MIDI, a serial data stream is used in this system, requiring a length of single-core shielded cable. The exact format of the signal is not being discussed, as patents are being considered. However, the receiving/decoding electronics are extremely simple, merely involving several 555 timers and shift registers (unlike MIDI with its UARTS, etc). To produce the output signal, use is made of the games port on the Apple. This versatile output port has several so called annunciator outputs, addressable by software. The interface consists simply of a 16-pin DIL header with the shielded cable connected to the appropriate annunciator and earth. Cable lengths are not critical, as the signal is integrated by a resistor/capacitor network before its subsequent transmission down the cable, and lengths of 40 feet or more have been used successfully.

The performance software

The foregoing has described a practical scheme now operating in several homes. The system presently specifies an original Ampico reproducing piano, an instrument scarcer than gold-filled hen's teeth. However, the pushup player mechanism used in the previously mentioned public performances represents stage one in the

development of an improved, smaller version.

The musical performances now used are all from reproducing piano rolls recorded in the first half of the century. While these musical offerings are highly valued by musicologists and can form a basis for a collection, recordings from today's artists would be necessary for economic viability. A method of recording live performances is presently being researched, and it seems that only minor technical difficulties are likely in the realization of a suitable recording system. The main problem concerns the dynamics of the performance, both in recording and playback.

Experience has shown that between 16 and 20 discrete levels of volume are all that are needed for the most discerning ear, with soft playing (pianissimo) requiring most of the attention. Recording the volume of each note by measuring the force or velocity of the key is done in most electronic pianos as a matter of course. However, playback assumes that each key is controlled independently, which is not the case here. Recall that only two vacuum levels are available at any one time; one for the treble notes, one for the bass. To cause a key note to sound within a chord, where the note and chord are all under the control of the same regulator, requires the key note to be played just before the chord. This allows the note to have a higher vacuum than the chord but the listener still hears them all at the same time. Obviously, any recording using this system would need processing to create the effect.

It is important to stress that for reasons of economy, any commercial system must be as simple as possible. The end justifies the means in many instances, and fooling the ear is valid if a successful but simple system results. In a commercial system, the ability to record from the piano could be an optional extra. Fitting this would present extra difficulties, although the SuperScope system provided this facility as standard. However, unlike the SuperScope system which used a tape-recorder, a computer based scheme could offer editing features. The existing system allows the speed of the performance to be varied, and an editing program is currently being written.

Looking to the future

If a viable self-playing system is finally developed, the implications for the entertainment industry are numerous. Performances by top line jazz, popular or classical pianists will become available on the rumpus room piano.

Imagine the changes in social habits. It is unlikely people would gather to hear recordings of pianists via the hi-fi set. But issue invitations for a soirée of music on a piano, and gatherings reminiscent of more genteel days could become the latest alternative to barbecues and video parties. Songs around the piano, or a concert featuring famous pianists will become living room past-times. Piano teachers and conservatoriums could also find application for a system that plays a piano as effectively as a live pianist. A more contentious use would be in places of entertainment, such as bars, restaurants and clubs, in the provision of dinner music.

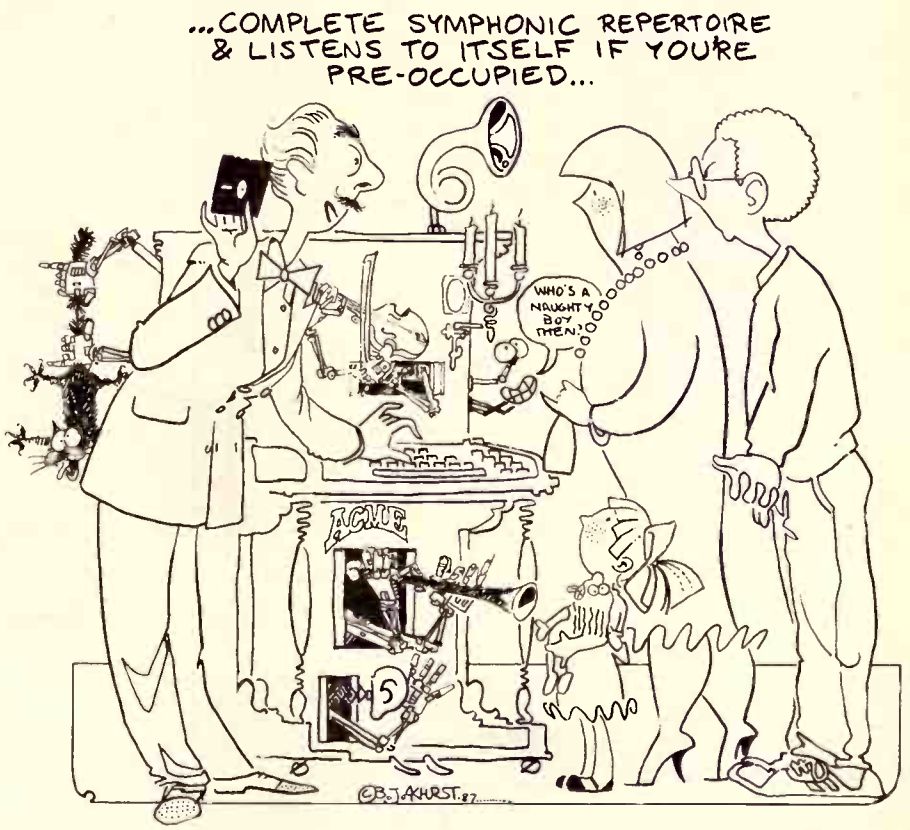
Other benefits that would accrue include yet another use for the home computer. As indicated, a basic 64K computer is adequate, and software for all the common varieties is only a matter of adaptation. With even larger computers, words to songs could be displayed on the screen; a sort of solid state pianolo roll. And of course, interfacing via the MIDI port to an electronic instrument is also possible. Where circumstances preclude a conventional piano, owners of any appropriate electronic keyboard could benefit by playing the available recordings using these instruments, widening interests and markets accordingly.

Significantly, however, the piano can now re-enter the home musical scene, made more useful by the computer that previously spent its time shooting aliens.

Conclusion

This article has attempted to show that it is both economically viable and musically valid to interface a computer to a conventional piano by way of a vacuum powered player. The suggested player is of the pushup variety, although integrated units are just as possible. A practical system is currently operating. Some 1400 individual performances are currently stored on approximately 100 disks. Selection and cataloguing is facilitated with a database program. By adapting an actual piano, rather than an electronic equivalent, the ultimate in sound is realized. Obviously, the better the instrument, the better the sound; an argument that applies to all means of sound reproduction. If ever loudspeakers can really replace the vibrating strings of a piano, then the proposed system becomes obsolete, but until then . . .. ●

Peter Phillips is a TAFE teacher of Industrial Electronics, and has written numerous articles on electronics for this magazine. His involvement in computers, electronics and music has culminated in the system described by this article. Interested readers are invited to correspond with him through our office.



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TEXAS INSTRUMENTS

ADVERTISING INFO No. 11

Extension of CD standard

Philips and Sony Corporation announced recently that they are expanding the applications of optical playback media with the development of two new consumer electronics products based on the popular compact disc technology.

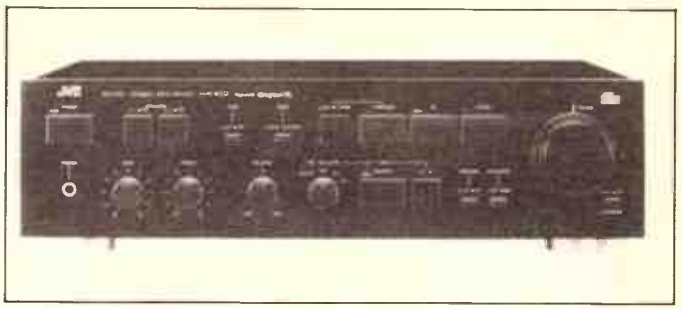
The CD disc with video allows the combination of both video and CD sound of five minutes duration (video clip) and 20 minutes of high quality digital sound on a CD disc (5 inch/12 cm). The audio portion of the new video single can also be played on existing CD players. In order to distinguish the video single from the regular compact disc, the colour will be golden.

The optical disc family now offers the software industry a medium combining CD sound with the superior quality of the optical video disc. It covers the full spectrum of software programming including music, music video, video clips, feature films, etc. While the new 5-inch disc will be an ideal medium for popular video clips, cartoons, and film trailers, the eight- and 12-inch discs offer excellent opportunities for a variety of entertainment programming, such as concerts, opera and ballet, video clip compilations and films.

In the future, both companies said, it is anticipated that combination players capable of reproducing all discs in the video and audio optical disc family will become available in order to meet consumer needs.

The companies also announced plans to work jointly to develop specifications for a convenient CD audio single compatible with existing CD players. The increasing popularity of the CD format has made it necessary to develop a CD successor to analogue 7-inch records, of which hundreds of millions are sold every year. The companies said that they are currently considering making the CD audio single a 3-inch disc capable of carrying up to 20 minutes of digital audio music and compatible with existing CD players by means of an adaptor. They stressed that extensive consultation with both software and hardware companies will be necessary before releasing the final specification.

The 'golden disc' is expected to have its first viewing at the Chicago CES in June.

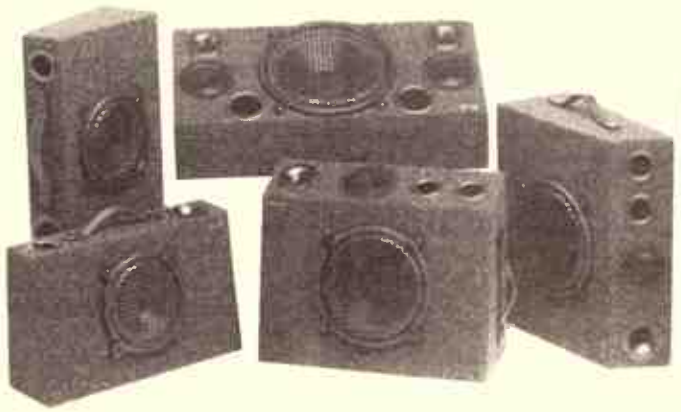


Extended JVC guarantee

Hagemeyer (Aust) BV, marketers of JVC products, has announced that as from last February, a five year warranty applies to all JVC hi-fi equipment sold.

Hagemeyer's Managing Director, Edwin Koemans, pointed to confidence in product quality as the reason and also invoked a reassuring slogan for JVC products, "Invest in quality". JVC celebrates its sixtieth anniversary this year.

The current JVC line-up includes over 40 products designed to cater for all segments of the hi-fi market.



The sound of the hatchback

Engineers at Mitek (USA) have developed a range of speakers for hatchbacks, vans and four-wheel drives that avoids rebuilding sections of these vehicles.

The MTX "Road Thunder" series comes in three models: the 35SB, an 8", two-way, 100 W model; the 45SB, a 10", three-way, 150 W model; and the 55HB 12", a three-way, 150 W model. Because of its size the 55HB comes as a complete enclosure, whereas the other two use two separate enclosures.

The speakers use polypropylene drivers along with a Thiele/Small aligned vented cabinet which MTX claims results in an extremely efficient system.

The speakers are covered in heavy duty aviation carpet in order to protect the interiors of vehicles when they are installed. Use outdoors is easy, depending on the length of speaker cable.

The speakers carry a 12 months' warranty. Enquiries should be directed to **Arena Distributors, 642 Albany Hwy, Victoria Park, WA 6100. (09) 361-5422.**

NTSC-PAL system converter

Conversion of American NTSC tapes to PAL for replay on Australian television sets is an expensive exercise. However GEC claims to be attacking the price barrier with the HD8000 Video System converter. This, it says, enables video users to realistically consider the economics of purchasing their own system converter.

The HD8000 has been developed with the budgets of universities, sub-broadcast production houses, govemment and industrial video users in mind. Using the latest digital technology such as 64K RAM, high speed ICs and a high density printed circuit board concept makes the HD8000 an economical compact system converter.

An in-built time base corrector enables the use of any video tape recorder as a video source without picture distortion. This is often caused by the relative instability of a VCR compared to broadcast signals.

GEC video systems division, which is distributing the HD8000 NTSC-PAL systems

converter in Australia, is able to arrange demonstrations of the system through sales offices in all States.

For further information contact **M.J. Andrews, at GEC Video Systems Division, (02) 887-6222.**

For the professionals

Among the latest professional audio products released by Tascam are a mixing console, a heavy duty balanced CD and a rack mount auto reverse cassette recorder.

The M-600 series mixer is the largest mixer ever produced by Tascam. All inputs and outputs (except direct out) are electronically balanced and a compliment of 16 pgm busses makes them compatible with 16-track recorders. Twenty-four and 32-input models are available with either single monitor (16 returns) or dual monitor (32 returns). All inputs and outputs are wired to 24-pin D-sub connectors which may be connected to an optional batam-type patch bay unit. A stereo input module is also available.

The new Tascam rack mount CD player features balanced XLR-type connectors and Teac's ZD low distortion circuitry. The player can be controlled via a remote function socket enabling remote fader start or dual machine control. The price of this unit is $1356 plus tax.

The Tascam 112R cassette recorder features auto reverse and a three-head reproduction system. It incorporates a hysteresis tension servo control to minimize wow and flutter and distortion. The 112R offers system expansion with a 16-pin connector on the rear panel which accepts an optional remote control and carries a number of expansion signals for multi-deck operation.

As well as these products Tascam has announced a new cue/review deck, a balanced patch bay, and an open reel master reproducer. It has also, incidentally, committed itself to the dash format for its digital recorders.

The Sanyo portable

Sanyo CD sound

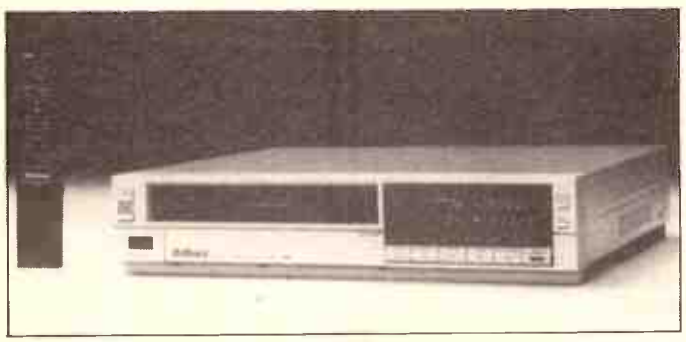
Two new CD players from Sanyo are now on the shelves of hi-fi distributors.

The CP08 features programmable 16-selection auto search and repeat controls. It is a front loading machine for flexible locating. The unit sells for $399 RRP.

The CP10 is a portable player which Sanyo describes as "barely bigger than the disc itself". It can be used with the home system and functions as a portable with an optional rechargeable nicad pack.

Its features include a programmable 16-selection auto search system, skip and repeat functions, 6-digit display of track number and elapsed time, and comes with a stereo headphone set.

The CP10 sells for $369 RRP and the optional battery pack for $89 RRP.



Another VCR

National Panasonic has released another range of VCRs under the title "New Generation" videos.

Amongst other things National claims that in still operation, the new NVG20A suffers not from noise or roll bars and recommends using it in conjunction with its NV-M5 VHS tape.

The player features a one-month, eight-program calendar timer and a special OTR or "one touch recording" which speeds up the setting procedure. When playing back, it includes a lap time indicator which precisely displays elapsed tape time. The NGV20A automatically ejects the cassette when rewound.

Other features include: VHS HQ system with edit function; 82 mm slim height; × 5 cue and review with search lock; 16-channel timer; channel skip; and 14-mode infrared remote control.

The NVG20A retails for $1029 RRP.

Recam video recording for PVS

GEC Video Systems division recently supplied a National half-inch broadcast recam video recording system to Professional Video Services (PVS), which operates a production and post-production facility in Melbourne.

PVS is using the National AU300 Edit VCR combination, with AU30 controller and timebase correctors. The broadcast standard editing system will be used to produce programs, particularly for Melbourne's real estate channel operated by Corporate Data Systems.

Videotape masters are produced on the recam system, then dubbed to low-band U-matic for transmission. The 500 W transmitter, situated in the Melbourne central city area, radiates on 2.1 GHz. Corporate Data Services is the holder of one of the two private licences granted for this type of service. Along with the recam system, PVS has also purchased a total of nine three-tube cameras from GEC Video Systems, including five WV888, two WV555, one WVN3 and one WV777 cameras primarily used on PVS's telecine chains for the transfer of standard and Super 8, 16 mm and slides to videotape.

For further information contact **M.J. Andrews, GEC Video Systems Division, (02)887-6222.**

Installation of car stereo

The installation of your car stereo is critical in how it will sound. It is possible to improve the performance of your car stereo by as much as 30 per cent by simply following a few inexpensive installation tips.

A little thought before you start the job will often pay off upon its completion. How often have you seen front speakers mounted in the front kick panels almost totally out of sight? This speaker placement will give your ankles great sound but not your ears! Try mounting your speakers in the door with a clear line of sight to them. By bringing your speakers closer to your ears you won't have to turn your stereo up so loud. Be careful, however, with the placement of your front speakers so as not to interfere with the operation of your window winder mechanism or door handle.

Mount the speakers on a piece of 5x16 inch marine ply or similar. Screw this mounting board onto the metal door frame and then attach your speaker and door trim to it. Make sure there is no movement of the mounting board, speaker or door trim. Then seal your door trim to the door with silastic or similar. By securely attaching your speaker to the door and ensuring that there is no movement or air leaks around the trim, your bass response should improve substantially.

For rear deck mounting speakers it is also recommended to mount these speakers on plywood, (or even replace the entire rear parcel shelf with plywood). Once more ensure secure mounting of speakers.

By isolating road noise from the interior of your vehicle you can once more improve the performance of your car stereo. A simple method to cut down the road noise in your vehicle is to install another layer of underfelt or dense foam rubber (yoga mats) under your car's carpet. You can also glue noise deadening material to the inside of your car's panels and engine compartment. This is available through most car accessory retailers.

A good quality speaker cable is also very important. Your speaker wire should be at least as thick as figure 8 lamp flex (like the wire you have on your bedside lamp). Good speaker wire improves the high frequency response of your system. If in doubt seek advice from your local hi-fi dealer.

A little extra thought and time spent on the installation of your car stereo will make dramatic improvements to its performance and your enjoyment.

Installation tips come from the Consumer Electronics Suppliers Association.

Turn your lounge room into a cinema

Pioneer has released a surround sound processor, the SPX 707, for the enhancement of your hi-fi or video sound, and emulation of the big cinema sound.

According to Pioneer, the effect of surround sound is created by a delay in the sound moving from front to rear speakers. Videos commonly nowadays have a specially recorded track which is accessed by the surround sound hi-fi component. Where there are no special tracks, the SPX can simulate to closely achieve a stereo wide sound.

The SPX features a dolby decoder and a full remote control. It retails at $595 RRP.

Broadcasters warn

Following an investigation of the current labelling of AM/FM stereo radio receivers by a national body of stereo AM radio broadcasters, Stereo AM Australia has (again) warned consumers wishing to hear both AM and FM stations in stereo to exercise caution when buying a new radio.

Only about 60 radio receiver models can currently claim (in labelling and advertizing) to be truly "AM/FM stereo" or "stereo AM/FM", since only these radios have a stereo capacity on both AM and FM bands. However, many receivers currently in shops are labelled and promoted as "AM/FM stereo" while in fact they only have an FM stereo and AM mono capacity.

Stereo AM Australia's chairman, Chris Brammall, has said that the Trade Practices Commission has agreed there would be value in an industry education campaign to overcome possible consumer confusion over stereo AM radio labelling. The Commission believed this would help consumers identify the equipment appropriate to their needs.

Both the Victorian Consumer Affairs Ministry and South Australian Department of Public and Consumer Affairs have also said that there is potential for consumers to be misled.

"We believe that under Sections 52 of the Trade Practices Act some retailers and manufacturers could be, perhaps unwittingly, giving the public misleading and deceptive information on radio receiver units," added Chris Brammall.

"Our advice to consumers is to be very careful when they buy a new radio. For if you want stereo on both AM and FM bands, try the product first to make sure."

Akai to extend guarantee

Akai, issuing statements under its new banner of "customer caring spirit", has announced the release of a VHS E180 video tape, guaranteed for 1000 replays.

According to National Marketing Manager, John Karbowiak, the long guarantee is warranted by what Akai sees as consumer confidence in its product, manifested in 20 per cent of all retail tape sales.

REMEMBER THE FIRST TIME YOU HEARD DOLBY SURROUND® SOUND IN A THEATRE?

WAIT 'TILL YOU HEAR IT AT HOME!

AUDIO

About the Shure HTS 5000

"Once you have seen and heard a proper Dolby Stereo movie presentation in your own home, you'll never be satisfied with ordinary, garden-variety television."

(With the Shure HTS 5000) ". . . the whole effect was overwhelming. Dialog was crisp and clean, and the stereophonic music and special effects were reproduced by the system with stunning clarity and impact."

"You can actually achieve a much higher quality of sound than in most Dolby Stereo theatre installations."

Bert Whyte

If you have *any* doubt about how good Dolby Surround® Sound is with home TV, read these brief comments by independent authorities.

STEREOPHILE

About the Shure HTS 5000

"It is rare in audio to find a clearcut "best" of anything, but in surround decoders, the Shure is the hands-down winner. Simply put, the reason is its superb sound. It has focus, detail, definition and aliveness that I'd not previously heard from any surround decoders or synthesizers . . ."

"The overall effect is spectacular and authoritative — precisely what one wants from theatrical sound."

Bill Sommerwerck

SHURE HTS 5000 HOME THEATRE SYSTEM

"AS GOOD AS OR BETTER THAN THEATRE SOUND"

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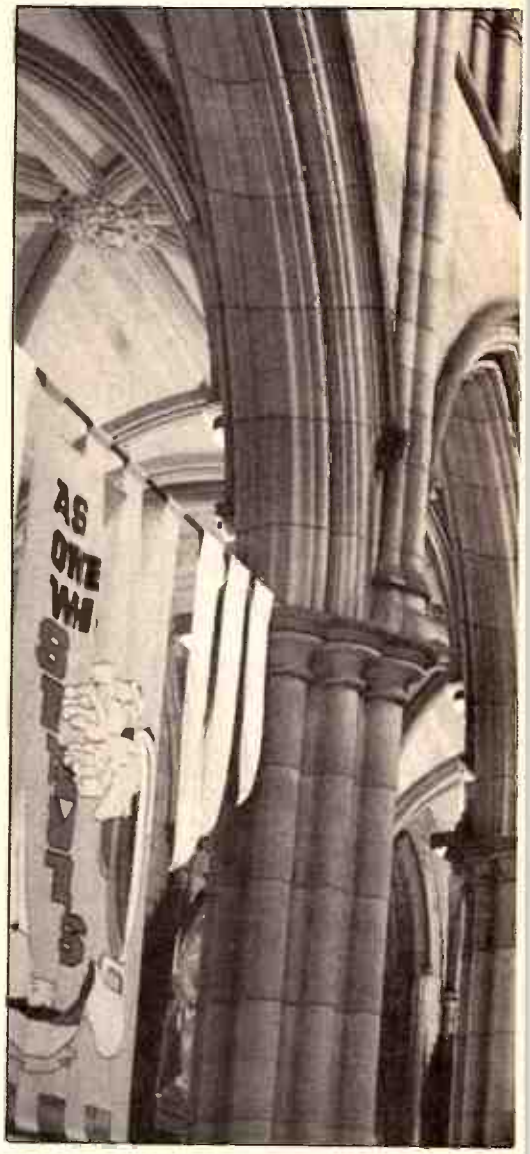
REVIEW

YAMAHA DSP-1

AWARD WINNING SOUND PROCESSOR

The "audible magic" of the Yamaha DSP-1 won it the 1986 Australian CESA Award.

Louis Challis

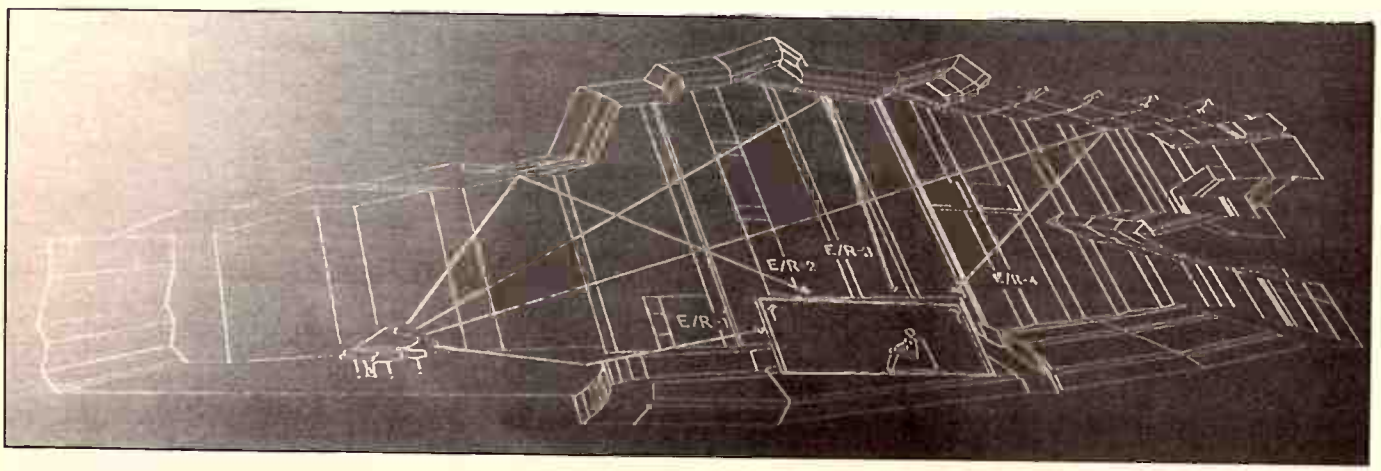


At the end of 1984 I visited the Yamaha facilities at Hamamatsu, which is a small city almost halfway between Tokyo and Osaka. Whilst there I spent a significant proportion of my time in Yamaha's 'acoustical analysis section' which has an instrumental laboratory and computing facilities. These were positively 'mouth watering'. Not only did they have a series of reverberation chambers of world standing, large anechoic rooms and 'state-of-the-art' instrumentation but more significantly, they had been using the facilities for many years to leapfrog their competitors in the development of new analytical procedures for the assessment of room acoustics — with the emphasis on large halls and auditoria.

One of the most unusual aspects of its facilities was the ability to use large powerful computers to analyse all aspects of the acoustical performance of auditoria by a series of analytical processes which were, and I suspect still are, unique.

Although at the time I did not initially realize the implications, Yamaha's research engineers have visited scores if not hundreds of auditoria and concert halls both in Japan and elsewhere in Europe and America. In each of these halls they had carefully measured *and recorded* the impulse response of the hall at different positions within the space (on the stage as well as in the audience area) so that each discrete echo and reflection, which controls the early decay times in the reverberation process, could be reproduced and/or utilized as a programming tool. The results of these analyses were then compared with classical acoustical theory, and then used as a basis for developing computer algorithms which allow the response.

Yamaha also has the means to turn these expressions into silicon. Whilst I was at Hamamatsu, I was shown how the integrated circuit development section of Nippon Gakki (Yamaha) have been in the forefront of the development of relatively inexpensive, large scale integrated circuits. It had also been working on powerful 8-bit



and 16-bit microprocessors. The need to provide ambience and realistic 'surround sound' provided Yamaha with all the impetus that it needed to take its advanced technology and inject it into its customer products division which is very much the older brother of the Nippon Gakki family.

Unlike the majority of other firms which have developed somewhat more staid electronic 'ambience' sound systems, Yamaha decided to break entirely new ground and to provide an ambience system which reproduces almost the full time history and frequency spectrum of a real auditoria's acoustical environment. Unlike the majority of other surround sound systems, it decided to provide this capability using six audio channels — two conventional main channels and four supplementary surround sound channels. To cater for the consumer market requirements for 'user friendly' simplicity, this ambience is provided at the 'touch of a button'.

The DSP-1 digital sound field processor has been "designed to reproduce the sound field experienced in a concert hall (and a lot of other different environments as well) in a normal listening room by simulating sound reflections from four primary directions utilizing the actual measured characteristics of the auditoria which are then fed to a series of extra amplifiers and surrounding speakers."

This previously unheard of feat is accomplished by a digital signal processor in which three ultra sophisticated digital integrated circuits are used. These LSIs generate the complex set of echo patterns and provide an unbelievable range of control for the user. The DSP-1 utilizes a 16-bit analogue-to-digital converter that operates on the sum of the input channels. It takes the resulting digital signal and separates it so as to generate four different ambience outputs. These four channels of digitally re-programmed data are then restored to ▶

YAMAHA DSP-1
(NATURAL SOUND DIGITAL SOUND FIELD PROCESSOR)

Dimensions: 435 mm wide x 72 mm high x 312 mm deep
Weight: 4.5 kgs
Price: $1499 RRP
Tested in conjunction with Yamaha Model M35 4 channel amplifier (RRP $500)

YAMAHA DSP-1

MEASURED PERFORMANCE OF YAMAHA DSP-1 REAR OUT
(NATURAL SOUND DIGITAL SOUND FIELD PROCESSOR)

HARMONIC DISTORTION

At 1kHz

INPUT =	1.0V	0.1V	
2nd	82.3	63.1	dB
3rd	75.3	61.8	dB
4th	-	63.9	dB
5th	83.6	57.6	dB
THD	0.02	0.18	%

At 100kHz

INPUT =	1.0V	0.1V	
2nd	-	74.4	dB
3rd	84.9	66.4	dB
4th	94.3	70.2	dB
5th	89.6	67.0	dB
THD	0.0069	0.019	%

At 6.3kHz

INPUT =	1.0V	0.1V	
2nd	84.0	58.3	dB
3rd	79.5	58.6	dB
4th	-		
5th	-		
THD	0.012	0.17	%

MEASURED PERFORMANCE OF YAMAHA DSP-1, MAIN AMPLIFIER
(NATURAL SOUND DIGITAL SOUND FIELD PROCESSOR)

HARMONIC DISTORTION

At 1kHz

INPUT =	1.0V	0.1V	
2nd	105.6	97.3	dB
3rd	-	97.7	dB
4th	-	-	
5th	-	-	
THD	0.0005	0.0019	%

At 100kHz

INPUT =	1.0V	0.1V	
2nd	108.5	96.2	dB
3rd	117.3	101.1	dB
4th	-	-	
5th	125.1	108.3	dB
THD	0.0004	0.0018	%

At 6.3kHz

INPUT =	1.0V	0.1V	
2nd	97.7	97.6	dB
3rd	-	97.1	dB
4th	-		
5th	-		
THD	0.0013	0.0019	%

MEASURED PERFORMANCE OF YAMAH DSP-1
DIGITAL SOUND FIELD PROCESSOR

SERIAL NO :	01262
INPUT IMPEDANCE	56 k ohms
MAXIMUM INPUT (clipping level @ 1kHz)	7.0 Volts
OUTPUT IMPEDANCES	1.4 K ohms
MAXIMUM OUTPUTS (Clipping Levels @ 1kHz)	
Main Channels	6.9 Volts
Center Channel	2.6 Volts
Surround Channels	2.9 Volts
(depends on program selected)	
FREQUENCY RESPONSE (See Curve) (-3.0db)	
Main Channels	3.5 Hz - 130 kHz
GAIN	
Main and Processing	0 ± 0.5 dB
NOISE & HUM LEVELS (see Curves) (Re Input/Output of 0.5V)	
Main Channel	86.8 dB(Lin) 96.5 dB(A)
Processing Channels	68.5 dB(Lin) 72.5 dB(A)
SEPARATION (See Curve) (@ 1 kHz)	
Main Channels	70dB

an analogue form in four separate 16-bit digital- to-analogue converters. This conversion is carried out with the same 44-.1 kHz sampling frequency used in the compact disc player system.

A series of different (standardized) early echo and reverberation characteristics for several performance spaces and auditoria have been encoded on a read-only memory (ROM) chip. When the type of environment the user wants has been selected, the DSP-1 uses the encoded information to process the incoming sound signal to simulate the characteristics of the space. Thus, for example, if the selected hall has a reflection from the side walls and back walls that reaches the listener 25 and 50 milliseconds respectively after the direct sound has been received, then the DSP-1 will duplicate those reflections. It does this by attenuating the input signals and sending them to the two front and two rear ambience speakers with the appropriate delays. What makes the DSP-1 different from any other ambience system on the market is its ability to generate up to 80 discrete echoes around the listener with the appropriate time delays and attenuation as would be measured in the original environment.

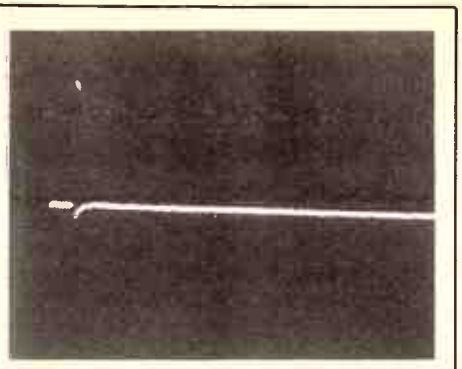
This achievement of this capability requires preferably four additional amplifier/speaker channels (over and above the two main channels that you already possess) to provide optimum performance.

However, in order to minimize the problem for those people who do not wish or can't afford to buy that much extra hardware, there is a built-in option for combining two of the front ambience channels into the two main channels.

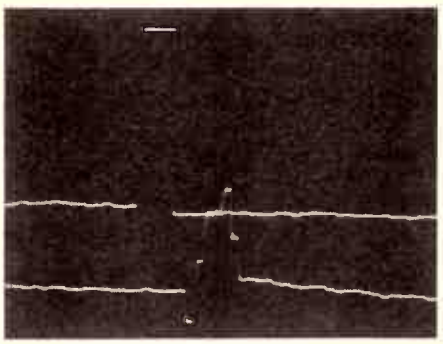
Physical characteristics

The DSP-1 is simply hooked up to your main amplifier in much the same way as other signal processors, with the preferred connections being between the pre-amplifier output and power amplifier input although a connection through the tape monitor loop is also possible. The major difference between this unit and any of the others available is that it provides three pairs of outputs, two of which are directed to the main amplifiers and speakers, one pair to the front ambience amplifiers and speakers and the third pair to the rear ambience amplifiers and speakers. A fourth set of outputs has been provided for separate mono full bandwidth channel or for a sub woofer output (200 Hz low pass signal) which is taken from the main channel signals.

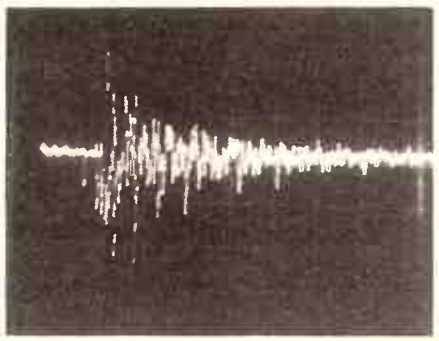
Sixteen different processing functions, which Yamaha describe as 'programs', are incorporated in each of the two primary



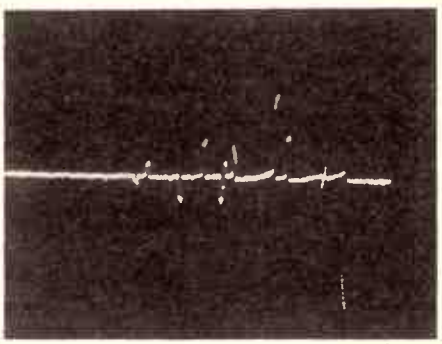
Test Signal (Input).



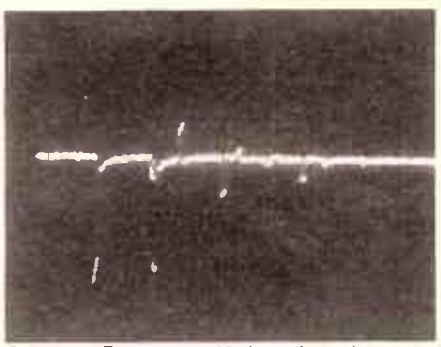
Response Programme 3: rear channel.



Response Programme 5: Munster Cathedral.



Response Programme 9: main amplifier output and front channel.



Response Programme 12: front channel.

processing modes. These are described as Acoustic Surround, which is used for generating ambience, and Sound Effector for the special musical effects. The Acoustic Surround programs are called: Hall 1, Hall 2, Hall 3, Chamber, Munster Cathedral, Church, Jazz Club, Rock Concert, Disco, Pavilion, Warehouse, Loft, Outdoor Stadium, Presence, Surround 1, Surround 2 and Dolby Surround.

The 16 effector programs are of primary interest to amateur recording artists and provide left-to-right channel delay, various stereo echoes, two flanging programs, two chorus programs, stereo phasing, tremolo, symphonic tremolo, echo room, two pitch change programs, which generate sounds up to one octave up in either semi-tones or in hundredth semi-tone steps and four automatic planning programs.

Each of these functions is clearly indicated by a light emitting diode (LED) display on the front panel, where the chosen program number is indicated and by a 32 character alpha numeric display which 'spells out' the description in words.

Hall 1 is apparently the Berlin Philharmonie, Hall 2 the Old Opera House in Frankfurt, Hall 3 the Concert House in Stuttgart, Hall 4 the Herkulessaal in Munich. Hall 3 provides two sub-settings, the first corresponding to the sound heard on stage and the second to the sound heard within the hall.

One of the most exciting aspects of the unit is undoubtedly its power to generate an unbelievably wide variety of additional settings, which are quite different from the standardized programs in terms of their ambience effects and other important parameters. You can vary the apparent room size, its 'liveness', the initial delay between the main channel sound and the processed ambience sound and the turnover frequencies for both the low and high pass filters. For the chamber Munster Cathedral and church programs, you can change the mid frequency reverberation time, the reverberation level and much to my surprise, the ratio of high frequency reverberation time to mid frequency reverberation time. The reverberation times can be varied between 0.3 seconds and 99 seconds, which is at the upper end of the audibly disconcerting range.

With the Dolby surround decoding, which utilises the standard filter delay Dolby B configuration, the rear channel delays can be varied between 15 and 30 milliseconds.

As if this weren't enough, if you alter one of the original factory encoded programs, you can save the changed parameters in one of the 16 free memories and even give it a name which is then stored ▶

with the program for subsequent display on the 32 character display.

All of these changes and primary program control are achieved utilizing the neat little infrared transmitter which looks just like a remote control unit. It features a colour coded set of multi-user keys with four main settings at the top labelled MEMORY, ACOUSTIC SURROUND, SOUND EFFECTOR and USER PROGRAM. The 16 switches below them provide either the corresponding standard programs or the 16 programs that would correspondingly relate to the primary control functions. At the bottom of the remote control transmitter are 10 additional buttons which provide the facility to change the title or name stored in the user program, as well as keys to mute the sound from the speakers, to mute the effects, to increase or decrease the parameter value (in terms of balance, reverberation time up or down, level effect or the decimal value of a parameter such as reverberation time or cut-off frequency).

Objective testing

The frequency response of the main channels was 3.5 Hz to 130 kHz and the hum and noise levels for the main channel relative to 0.5 volts input level were a very healthy 86.8 dB unweighted and 96.5 dB (A-weighted). These figures will obviously be higher for higher inputs, especially as the clipping level for the main input channels are 7 volts at 1 kHz. The output from the main channel for that same 7 volts input was 6.9 volts, the outputs of the centre and surround channels were 2.6 volts and 2.9 volts respectively, although the surround channel output is, as it transpires, dependent on the actual program channel selected.

The frequency response of the surround channels is far from linear as the level recordings clearly show. The distortion figures for both the main output and rear output channels were remarkably low and far better than I might have expected considering the extent to which program content is modified during the encoding process. In order to assess the characteristics of the equipment, I carried out a number of unusual assessments including photographing the output of the various channels using a digital storage cathode ray oscilloscope. These photographs were recorded with various time scales to capture both the initial transient characteristics and the longer term oscillograph of the multiple echoes. These measurements were supplemented by plots of the reverberation time using the same equipment and procedures that we would normally use when assessing the reverberation characteristics of a real auditorium.

With the knowledge that the reverberation generation process is in fact closely duplicating the real phenomenon, I wasn't particularly surprised to find that the reverberation times and characteristics were both realistic and believable. The frequency flanging looks for all the world like the effect of attempting to record the frequency response of a loudspeaker in a real room, as opposed to the anechoic room which we utilize when measuring loudspeakers for inter-comparison purposes. All of the measured parameters of the unit are in very close agreement with the stated values as specified on the front panel display and I found that I could utilize the signals generated as quasi calibration signals for my laboratory instrumentation.

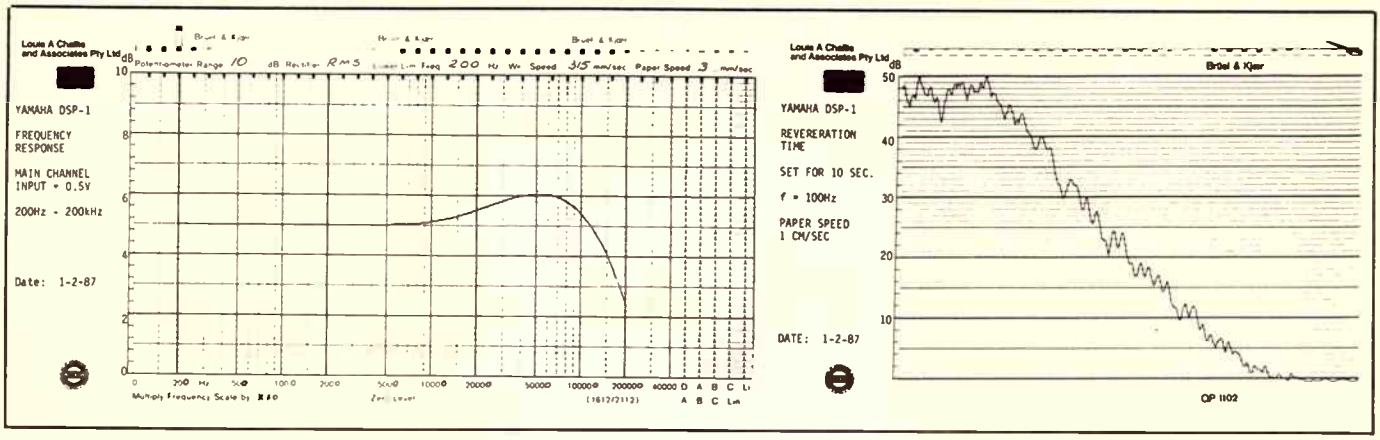
Subjective Testing

It is hard to find the appropriate superlatives to describe the degree of subjective realism which this unit can provide. I coupled the output of a Yamaha CD-2 player to a Yamaha C2 — a preamplifier whose stereo channels were then fed into the DSP-1. The primary channels were fed to a Yamaha M80 amplifier and then to a pair of B&W 801F speakers. The ambience and surround channel outputs were fed to a Yamaha M35 amplifier whose signals were fed to a pair of B&W DM110's and a pair of Fisher monitor speakers.

The results were audibly assessed by comparing the primary sound fed into the main channels, without any ambience or surround sound being added, with the resulting audible signals provided by the ambient speakers as each separate function was selected. Although I had doubted my ability to be converted so quickly, within a short space of time both one of my senior associates, my younger son and I were convinced that the DSP-1 was not just a new toy but more significantly a 'state-of-the-art' advance in audible signal processing. We played literally dozens of new discs, old records, extended samples of classical orchestral, as well as rock and pop music to assess the unbelievable wide range of functional settings that were readily available at my fingertips.

The original recorded sound without the ambience or reverberation characteristics of the selected recording hall, auditorium or disco were magically transformed into precisely what they stated they were, with a degree of realism and audible characteristic which I found to be strangely uncanny — if not magical. I found that I could shut my eyes and imagine I was there without any problem whatsoever.

At a selling price of $1499 Yamaha Australia (and most probably Nippon Gakki in Japan) will be hard pressed to keep the supply up to the demand. This unusual device is equally at home in a recording studio, school hall, private home or music workshop. Each and every one of those potential users, once exposed to the power and 'audible magic' of this unit, is likely to be out there placing his or her order. If ever a piece of electronic equipment justly deserved a consumer electronics award for technological innovation this unit does and I was pleased to see that it won the 1986 Australian CESA Award. ●



27 MHz AM transceiver

Build a hands-free operation, crystal-locked AM transceiver. Amaze your friends by talking to them over long distances!

S. K. Hui

Part 1

IT'S BEEN almost a year since ETI has published any radio frequency (rf) projects. Finally, here comes a well designed rf circuit for you, the ETI-684 am transceiver.

The idea of this project actually came from aircraft communication. On one occasion, the editor and I were invited to have a test flight in a locally designed ultra-light aircraft. This is the first two seater ultra-light approved by the Aviation Department. Its only problem is that it's impossible for the occupants to talk to one another, even though they're sitting shoulder to shoulder. The turbulance and engine noise make it almost impossible to communicate. Just imagine how troublesome it is for an instructor to teach a deafened pupil to fly!!

The simplest solution would surely consist of a mic, amplifiers and speakers connected together by wire. But this would be all this circuit could do. Clearly, rf link would be a lot more useful. Not only would it find applications in the above situation, but in many others: walkie-talkie, links between motorcycles, cars in convoy, etc. What makes it particularly attractive is the hands-free operation of the unit, making it suitable in areas where operators are too busy to 'press-to-talk'.

Design considerations

I did a lot of thinking on the type of modulation, the carrier frequency, cost, convenience of building and legal requirements of this project. There are four frequency bands worthy of consideration. A band around 910 MHz can be used but it's rather tricky to set things up there. Very few people would have the gear to deal with a frequency this high.

There is another band at around 203 MHz used by TV and radio but operating in this band might interfere with your neighbour's favourite newly wed game program. Around 88 to 90 MHz there is an empty slot in the broadcast band, but it's (a) illegal, and (b) in Dec '85 we ran another project using it.

After a lot of soul searching, it seemed to me that a 27 MHz crystal-locked AM system would be the best compromise between ease of construction, legality, antenna length, interference and power. The band is populated by radio remote control systems as used in toys and models, and by walkie-talkies. It also requires a long antenna for efficient radiation, but in this band, an output transmitting power of less ▶

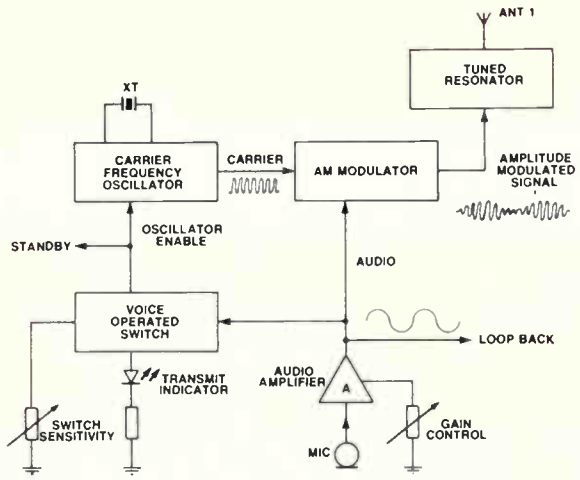


Figure 1. Block diagram of transmitter.

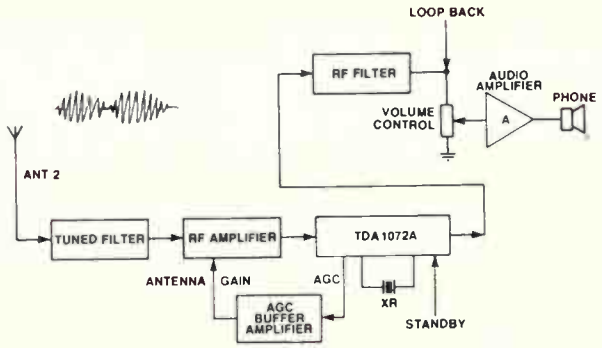


Figure 2. Block diagram of the receiver board.

than 100 mW means one does not require any licence.

It also minimizes the problems of working with high frequency design. One of the difficulties of working with radio circuits is the low gain of transistors operating at high frequencies. High loss in normal resistors becomes intolerable and tuned circuits for extracting small signal from noise need to be employed.

Circuit design

The complete unit consists of two pc boards, one containing the transmitter and the other the receiver, separated by standoffs. A battery is also included in the box. To make a viable communications system, two of the units are required. A block diagram (Figure 1) shows the essential features incorporated into the transmitter board. The receiver board is for converting the received rf into an audio signal and, therefore, as shown in Figure 2, has quite a different structure from that in Figure 1.

The transmitter board has a crystal-controlled carrier frequency generator which is enabled or disabled by the output of the voice controlled electronic switch. The reason for having this set-up will be apparent later. The amplitude of the carrier signal from the oscillator is then modulated by the audio signal in the modulator, hence the name amplitude modulation (AM). The AM signal is then further amplified by the tuned resonator before driving the antenna. An LED indicator is included which will be lit up when the unit is in transmitting mode. During standby, the unit is in receiving mode with the LED off.

Referring to Figure 2, the receiver board has a tuned filter set to 27 MHz to pick up the carrier signal. The signal is then amplified before getting to the AM

BOX MAKING

Before I committed myself to making a pc board layout, I tried to find a box of the correct size. The right sort of box has to be non-metal, low profile, reasonably cheap and common to obtain. Given the choice of boxes in the hobby shops, that left me with no alternative but to design my own custom made box tailored to the exact dimensions wanted.

The material I chose to use for the prototype was 3-ply wood. It can be obtained either from a model-making hobby shop or any timber selling place. Perspex is another material worth considering. But if you choose to follow the dimensions given here, the thickness of the 3-ply must be 4 mm. The box is built from six separate pieces labelled from A to F. The cutting dimensions of the six pieces shown in Figure 5 are all in millimetres (mm). Use Figures 5 and 6 to help you understand the next few paragraphs.

To cut a straight line on the 3-ply, the best tool is a sharp scalpel and an accurate metal ruler. Firstly, mark out the piece you want to cut on both sides of the wood. Score the wood along the marked lines with a scalpel and a ruler. Just break the wood along the cut. Cutting with a hand saw is not recommended as it leaves a rough edge to be smoothed out later.

After cutting the pieces, the next problem is to drill holes. Three of the holes (e, f and g) need to be counter sunk to account for the thickness of the wood on the sockets. Holes f and e are for the 3.5 mm phono sockets, SK1 and SK2. Hole g is for the antenna socket SK4, which is a 2.5 mm phono socket. Hole g is also countersunk to a 3.5 mm phono socket (SK3), if you want to use rechargeable batteries. Skip that hole if you are going to use normal batteries instead (see battery section). Holes j and k are for two 4BA countersink head screws.

To assemble the box, only panels from B to F are used, the lid (A) will be dealt with separately later on. The glue used was five minute quick dry Epoxy. The five pieces are glued together as shown in Figure 4. Check that the box is not tilted or twisted in any way. A right-angled ruler would help to get this right. Leave the box like that overnight to allow the epoxy to acquire its full strength. Next, smooth the box with sand paper. Use a coarse grade until the joints between panels are smooth, then finish off

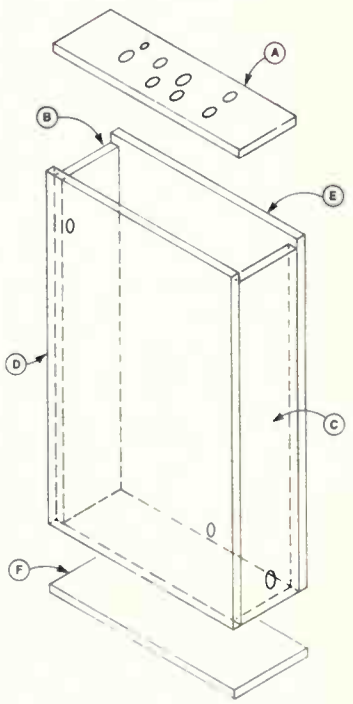


Figure 4. Assembly of the box.

with a fine grade sandpaper.

At this stage, you wil probably find that the lid won't land on the box. Don't worry, this is the way it should be. Use fine sandpaper to smooth off the side edges of the lid slowly until it just fits in. Further smoothing on the top and bottom edges is required until they are level with panels B and C when sitting on the box. The whole thing sounds a little tedious here but I'm sure any handy man could do a better job than me. The motto is: If you want a good looking box, take your time!!

Next is the paint job. A single coat of matte black will suffice to protect the timber of the box. However, if you want to tart it up a bit, there is no substitute for a lot of paint. Between each coat, use wet and dry sandpaper. The result, especially when the Scotchcal panels are in place, is a very professional looking unit.

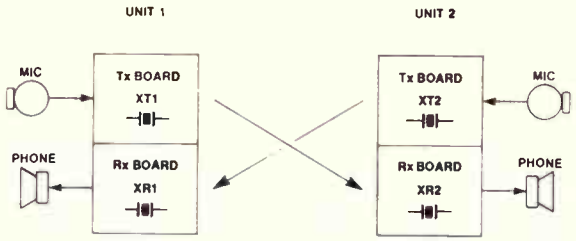


Figure 3. Complete communication system. Crystals XT1 equals XT2, XR1 equals XR2, and XT1 minus XR1 equals 455 kHz.

hybrid receiver chip TDA1072A (IC2), the star of the show!!! The majority of the functions done in the receiver board are controlled by this integrated circuit (IC). The IC has an internal double-balanced mixer, IF amplifier, balanced full wave detector, audio pre-amp, automatic gain control (agc) amplifier and an indicator driver. The LED indicator driver has a dc voltage output proportional to the agc signal.

The agc dc voltage is buffered and used to shut down the rf amplifier when the received signal gets too strong. The chip makers claim 1.5 μV sensitivity but in real life, I could only get 30 μV. Fortunately, the tuned rf amplifier provides a signal gain of around 12 to 30, depending on how well it is tuned so that the overall sensitivity of the receiver board varies between 2.5 and 1 μV.

The audio output from the IC is not directly usable. A simple rf filter is needed to remove any high frequency mingled in the audio signal. The purified signal is then ampified to drive the headphone.

Signals that you hear in the headphones are not only received off air during transmission, but also via 'sidetone', ie, some of the signal from the microphone is fed around to the headphone so that you can ▶

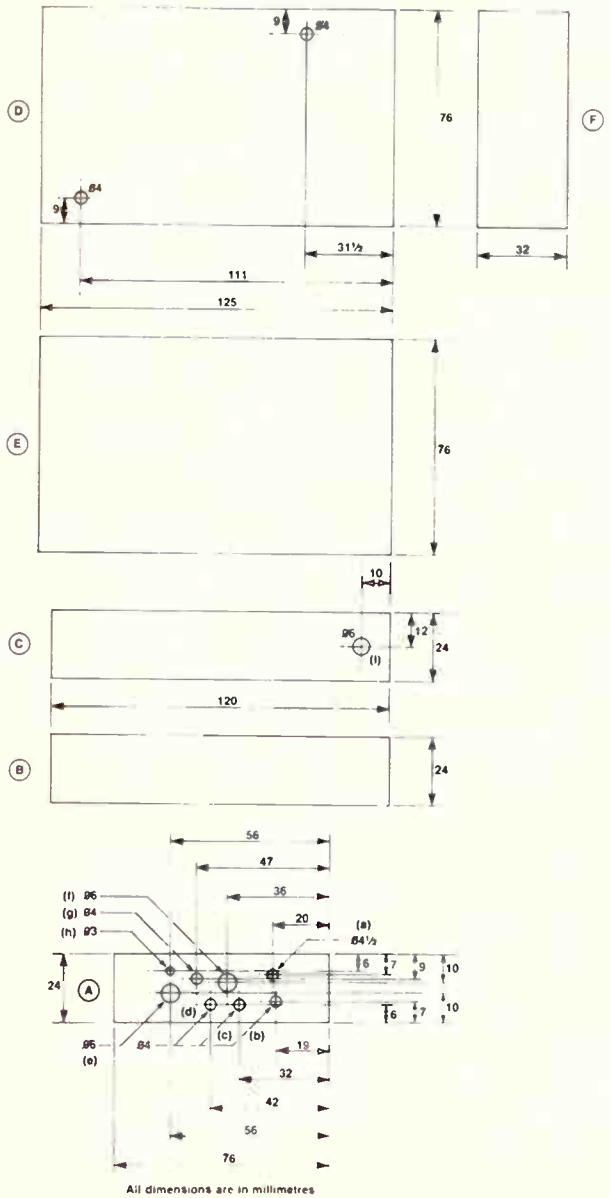
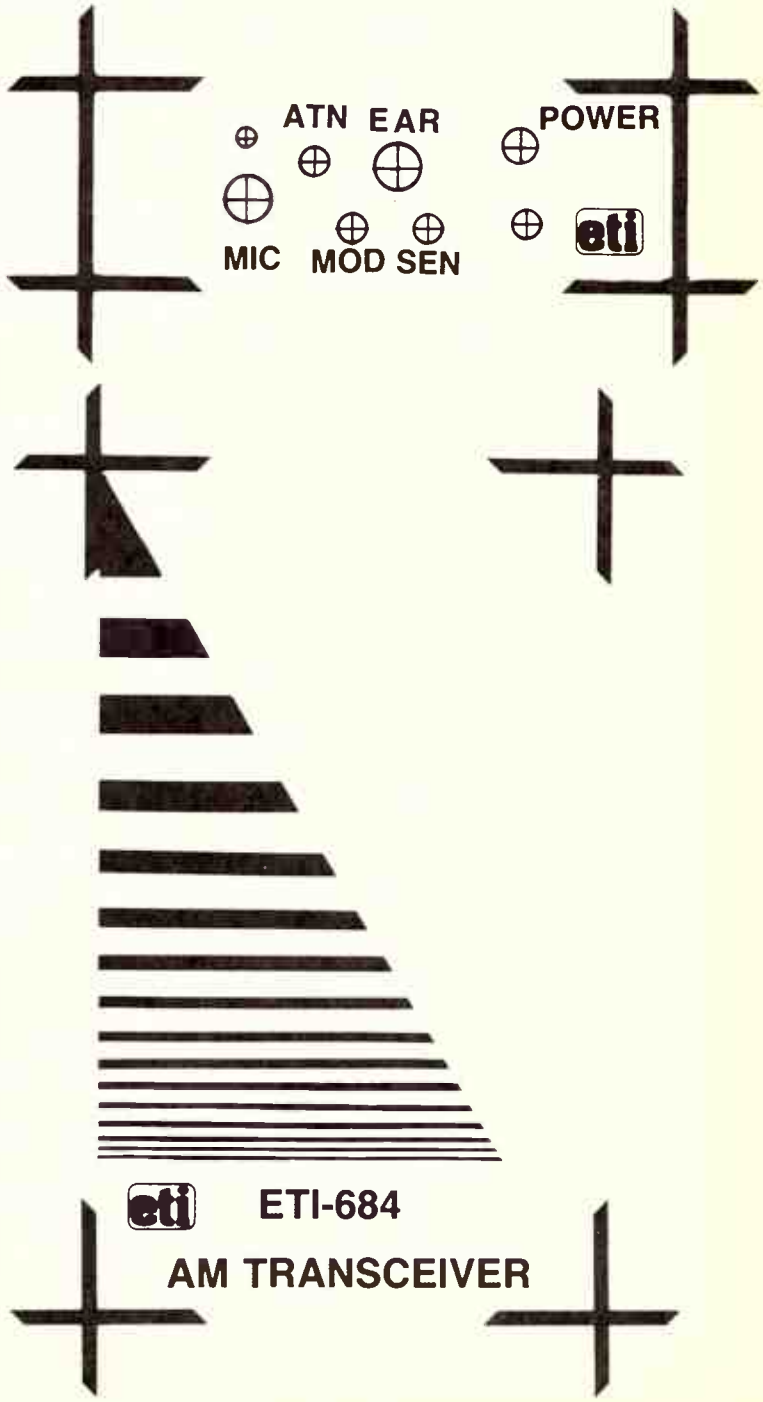


Figure 5. Cutting and drilling of the six pieces.



hear yourself. It's a technique also incorporated in telephones.

Since the system is crystal-controlled, the crystals used in the transmitter and receiver have to be matched. The complete communication system shown in Figure 3 requires four crystals with XT1 equalling XT2 and XR1 equalling XR2. Furthermore, the frequency specified for XT1 (XT2) and XR1 (XR2) has to differ by 455 kHz. For example, in my prototype XT1 and XT2 are 27.165 MHz and XR1 and XR2 are 27.620 MHz. Usually they are sold in matched pairs.

Communication protocol

In any rf link, bandwidth is always the prime consideration in the design. In most cases, the less bandwidth you use in doing what you want, the better it is. That is the reason why in most walkie-talkie devices, half duplex is used. The communications channel is only wide enough to allow one way communications. Full duplex allows you to talk and listen at the same time, so, all things being equal, it requires twice the bandwidth.

The idea of having the voice-operated switch in the circuit is to eliminate the manually operated 'press-to-talk' button that is necessary in a half duplex system, giving the pilot hands-free operation on the unit. When turned on, the unit is usually in the receiving mode. If nothing is being received, all you hear is hiss.

The voice operated switch keeps the unit in this mode until the microphone picks up enough signal to toggle the electronic switch into transmit mode. It stays in this mode as long as the microphone signal persists. The switch does not toggle immediately but waits for a second or two. This is to prevent it leaving transmit mode if you happen to stop to draw breath.

Thus, the way to operate the system is to arrange for one person to talk, while the other listens. To terminate a message, some specific code should be used. The traditional 'over' is good enough. The receiver must now wait for one or two seconds before starting to speak, while the original radio is switching back into receive mode.

One word of warning: don't tune the sensitivity and the gain of the microphone amplifier up too high. It's not difficult to turn the amplifier up so high that your breathing, the wind or anything else will trigger the electronic switch. When this happens you will not be able to receive. Incidentally, one of the reasons we decided not to include a squelch system was that the background noise is the only indication the operator has that the unit is receiving. ●

ETI-746 — HOW IT WORKS

TRANSMITTER BOARD

On the transmitter board, you will find an audio microphone amplifier, electronic switch, the rf oscillator, the AM mixer and the tuned amplifier for radiation. Following the signal through the circuit, the first component we encounter is SK1. A 3.5 mm phono socket connects the microphone signal into the mic amplifier. For a single 9 V supply, the dc voltage on the output of the op-amp (JF-351) should normally be sitting at 4.5 V for maximum swing without clipping. To achieve that, pin 3 of the JF-351 should be at 4.5 V, ignoring the small amount of dc input offset voltages. This requires resistors R1 and R2 to be equal (so as to divide the 9 V to 4.5 V at pin 3). The input impedance seen by the microphone is R1 and R2 in parallel. As a rule of thumb, it should be about 10 times the impedance of the microphone. For a common 600 ohms mic, R1 and R2 are quickly worked out to be 12k each. Capacitor C1 and the combined resistance of R1 and R2 (6k) forms a low pass filter for the microphone signal. With the value chosen for C1, the cutoff frequency of the filter is around 12 Hz.

Integrated circuit IC1 forms a one stage amplifier for the mic signals. As JF-351 is a high gain bandwidth product op-amp, it is chosen to do the job. With the trimpot RV1 turned to minimum resistance, the gain of the amplifier is just:

$$1 + \frac{R4}{R3} = 821, \text{ with } R4 = 820k, R3 = 1k.$$

With RV1 turned to its full maximum resistance of 500k, total gain of 1321 can be achieved. Such a high gain is provided for situations where it may be required, but it will not always be an advantage. In high noise environments, the noise itself will trigger the voice operated switch. Capacitor C6 and R3 form the low frequency roll-off mechanism of the amplifier at around 72 Hz. The amplified microphone signal is used to trigger the voice operated electronic switch and modulate the carrier signal amplitude in the modulator.

The carrier amplitude is more or less a constant for a given battery voltage, but the audio signal is not. The louder you talk, the more microphone signal you will get. The same result could be obtained by changing the gain of the op-amp (IC1) with RV1. The larger the audio signal from the op-amp output, the more modulation will be on the carrier. Therefore, to be exact, trimpot RV1 is actually a modulation control. Hence the labelling used on the front panel for RV1 is MOD.

VOICE-OPERATED ELECTRONIC SWITCH

The electronic switch consists of three transistors Q1-Q3, resistors R5-R12, R22, capacitors C9-C11 and diode D1. Part of the audio signal from the op-amp is tapped from RV2 via C7. Transistor Q1 is biased with collector-base feedback resistor R7 forming the first stage in the electronic switch. Transistor Q1 gives a further 50 in gain and buffers the signal with its high output current to drive the timing circuit. The timing circuit is formed by C10, R9, D1, C11 and R10. The almost squared audio signal (due to the gain in Q1) appearing on the collector of Q1 is ac coupled into R9 and D1. Initially, C11 has zero voltage across it and any positive going signal appearing on R9 simply causes the diode to conduct. Capacitor C11 charges up. The negative going signal on R9 turns off the diode and stops the current from flowing back to R9 from C11. This negative going signal discharges through R9 into ground with a time constant equal to 2 (C10) (R9) = 0.3 seconds. Once the negative going signal has discharged, the cycle is ready to repeat itself. On the other hand, charge stored in C11 discharges with a much slower rate through a high resistance R10. If you keep yelling at the mic, a dc high voltage will be experienced across C1 and keep the transistor Q2 turned on.

Using the analogy of signal as water, the op-amp and Q1 are just hoses pumping water into a large bucket C10. This bucket empties itself to a smaller one, C11, which has a hole, R10, with water leaking through it.

The output of Q2 is inverted to get the right polarity and is further amplified by connecting it to a pnp transistor Q3. The extra gain from Q3 is needed to achieve an extremely fast rising voltage on the collector of Q3. Some people call this fast 'attack'. Having C10 ten times bigger than C11, so that C11 can be charged up quickly, also helps provide fast attack. As soon as you start talking into the mic, the voltage on the collector of Q3 rises quickly to V+ and causes three things to happen: LED1 lights up Q4 so as to oscillate and so provide carrier generation; the signal is carried to the receiver board via a wire link (C) to disable the receiver chip TDA1072A (IC2).

OSCILLATOR AND MODULATOR

The oscillator comprises XT, R13-R16, C12 and Q4. Normally it is in standby condition and waiting for D2 to turn on. The conducting D2 connects a high voltage V+ onto R13 and allows the circuit to oscillate. Since the oscillator is crystal-locked, the oscillation frequency will be the same as the crystal frequency. The carrier signal is coupled to the gate 1 of the dual gate MOSFET transistor Q5 for modulating and amplifying.

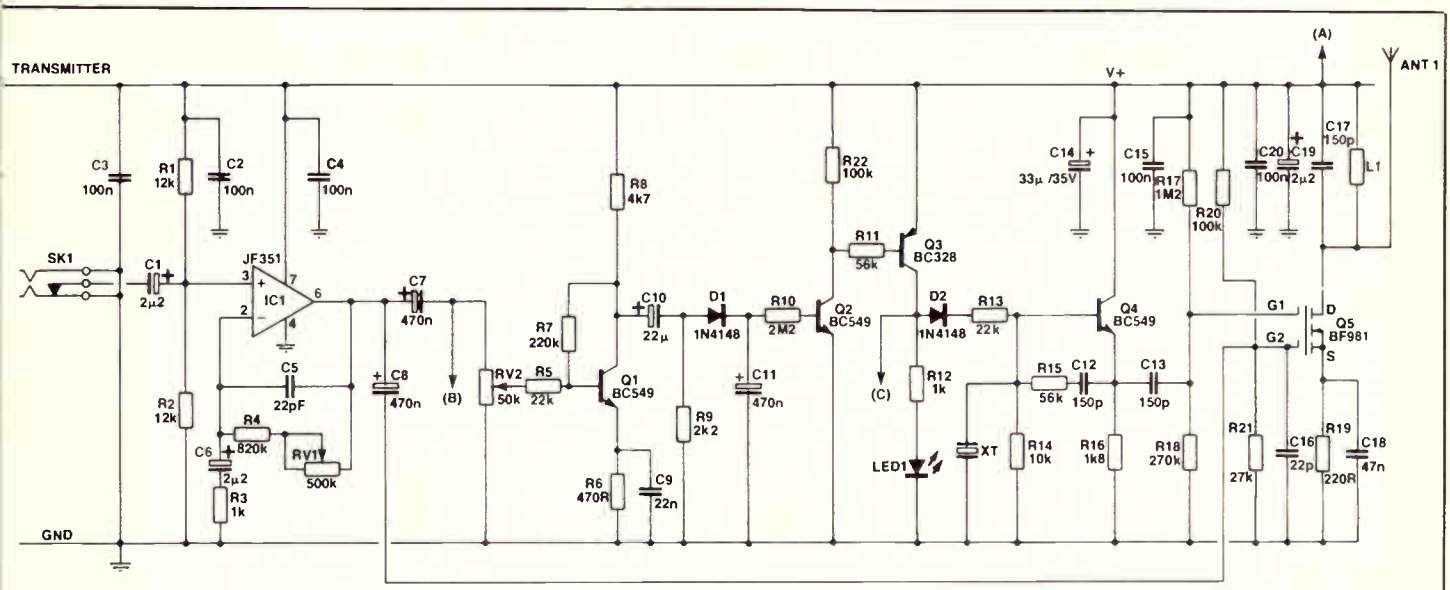
The amplitude modulation of the carrier signal is carried out at gate 2 of transistor Q5. A varying voltage on gate 2 would change the carrier signal amplitude on the drain output. This varying voltage is derived from the output of the op-amp IC1 via C8. Once again, the combined resistance of R21, R20 with C8 determines the low frequency cutoff point for the audio signal. It works out to be around 16 Hz.

RESONATOR

The resonator is formed with C17, L1 and the antenna ANT1. It is basically an LCR parallel tuned circuit which gives maximum impedance at 27.5 MHz frequency. The idea is to tune the coil L1 until maximum voltage appears on the drain of Q5.

RECEIVER BOARD

Signals picked up by antenna ANT2 are coupled to the first bandpass filter L3 and C21. A bandpass filter antenuates all other frequencies except the centre frequency which is tuned at around 27.5 MHz. Output signal from the filter is further amplified by Q6 and the second tuned resonator formed by L4 and C24. The overall gain on the sig-

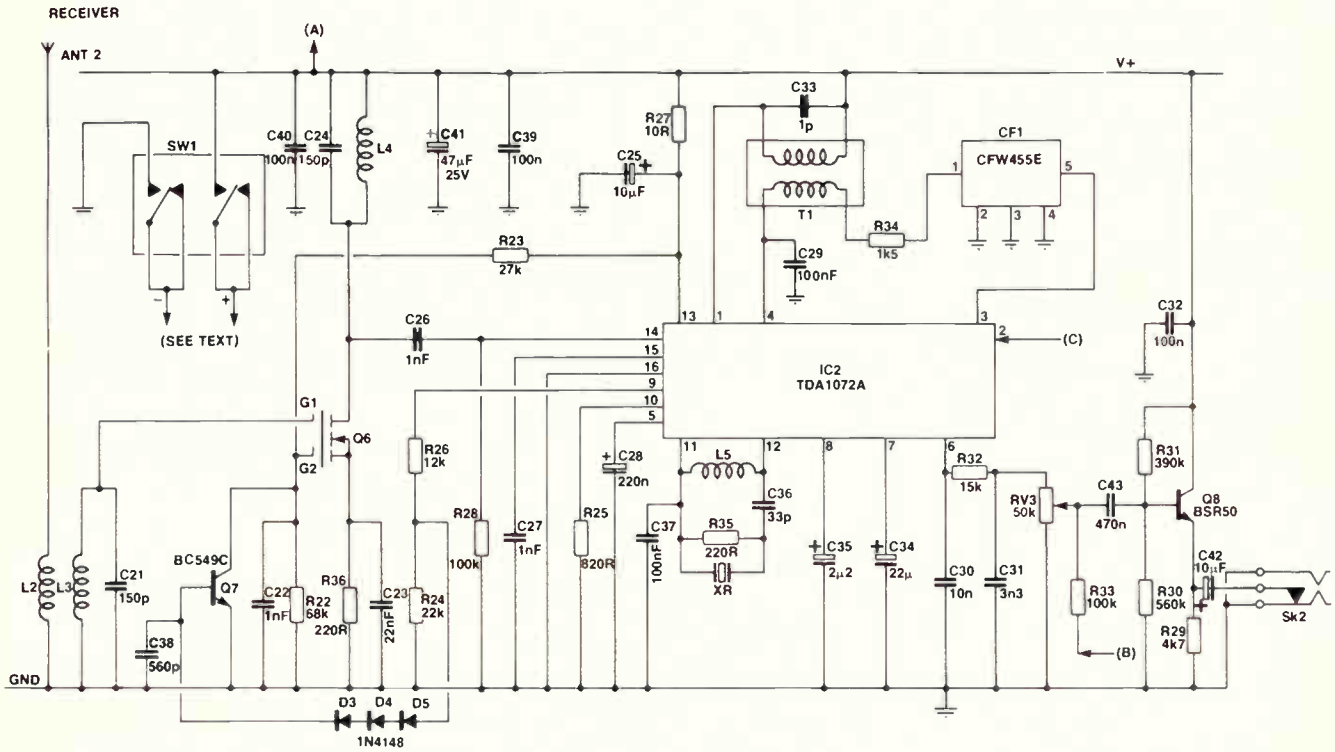


nal from the antenna input to the drain of Q6 is about 12 to 30. This is then coupled onto pin 14 of IC2 via C26.

The centre of attention in the receiver board is the TDA1072A (IC2). Inductor L5, C36, R35 and XR are the key components required by the internal oscillator in the chip. If the internal oscillator of the chip is running properly, its output signal should appear on pin 10. Pin 2 of the chip controls the standby operation of the IC. A high on this pin causes the chip to go standby and a low (0 V) enables the IC to receive. An internal double balanced mixer is used to generate the IF signal. The mixer output (pin 1) is the collector of a transistor pair which requires a positive dc voltage for biasing. Using a resistive load to supply the dc voltage would reduce the maximum IF output signal; an inductor should be used in coupling the mixer output to the IF amplifier (pins 3, 4). In the actual circuit, an rf transformer (T1) is used. The output signal from the transformer does not return to the IF amplifier immediately. The in-built high IF gain amplifier allows the IF selectivity to be provided by an external ceramic filter (CFW455E).

A buffered dc output which is a logarithmic function of the aerial input voltage over the full dynamic range is available on pin 9 for driving a field strength indicator. In the design, pin 9 is used to drive gate 2 of Q6 with the help of Q7, D3, D4 and D5. Gate 2 on transistor Q6 controls the gain of the amplifier and will shut it down in the event of receiving a strong signal. In situations where the transmitter is too close to the receiver, signal received would be strong enough to swarm the rf input stage of the IC. Some kind of feedback mechanism to shut down the rf amplifier is quite essential.

Finally, the demodulated AM signal appears on pin 6 which is connected to an internal audio preamplifier with an emitter-follower on the output stage. Such a low impedance output stage enables a low pass filter to be constructed externally, for filtering the residue rf component in the audio signal. The audio output from the low pass filter is tapped from the trimpot RV3 and mixed with signal from the output of IC1 via C7(B). They are then amplified by a Darlington transistor Q8 to drive the headphones.



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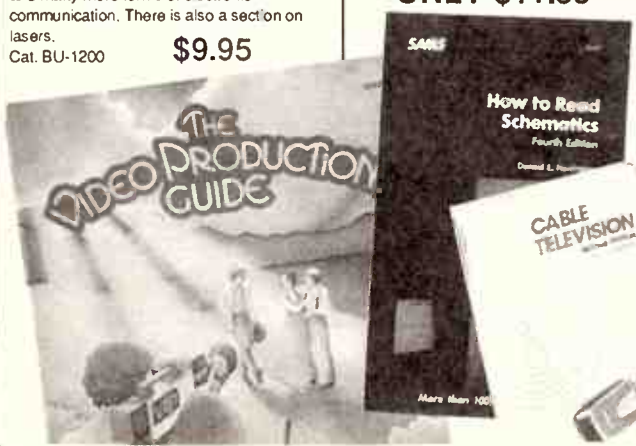

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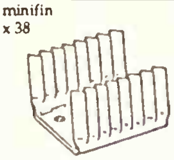

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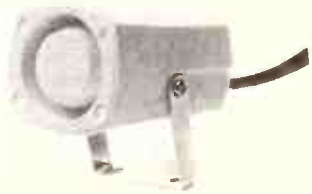

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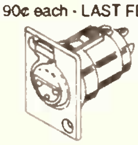

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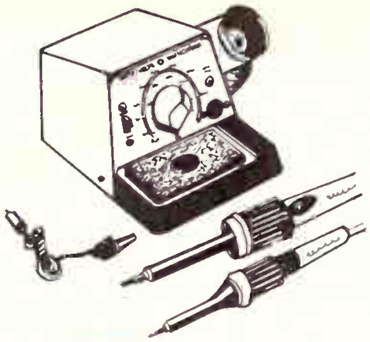

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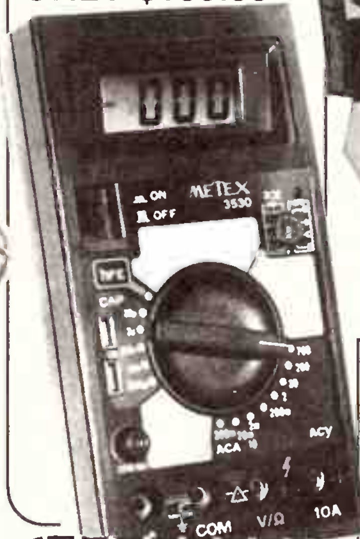

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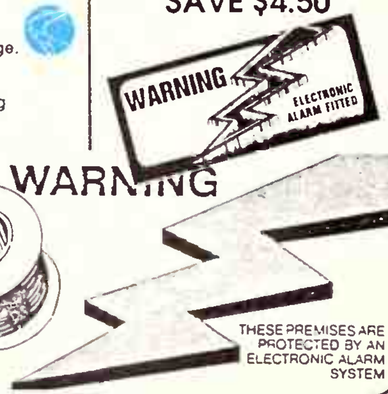

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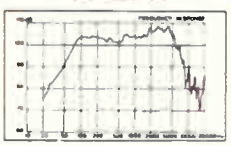

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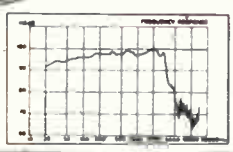

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QUARTZ CRYSTAL CLOCK MOVEMENT

SUPPLIED WITH 3 SETS OF HANDS

Very compact unit (56mm square x 15mm deep) that can be used in your own design of clock face. Self starting one second stepping motor has strong torque. Powered by 1 x 1.5V AA battery that lasts around one year. Accuracy is ±15secs/month.
Cat. XC-0100

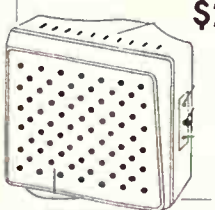
ONLY $12.95

FRIGI-FRESH

ELECTRONIC REFRIGERATOR DEODORISER

This unit automatically circulates the air in your fridge after each door opening. A special filter removes odours and circulates a fresh smell through your fridge. The unit turns off after 12 seconds. Uses 4 x AA cells (not supplied).
Size: 100(W) x 90(H) x 88(D)mm. Simply sits at the back of your fridge on a shelf.
Cat. YF-5522
Spare filters Cat. YF-5523 $3 ea

$24.95



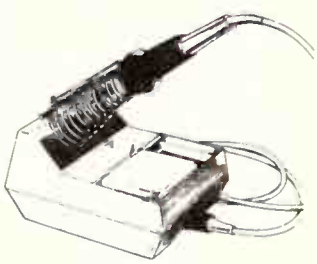
NEW FOR '87

BONUS OFFER

WELLER WTCPN SOLDER STATION

Buy the Weller station in April and receive a BONUS 2 rolls of solder absolutely FREE. Full details on the Weller WTCPN in the 1987 Jaycar Catalogue.
Cat. TS-1000

$149.50



ULTRASONIC PEST & INSECT REPELLER

(Full details 1987 Jaycar Catalogue)
Cat. YS-5510

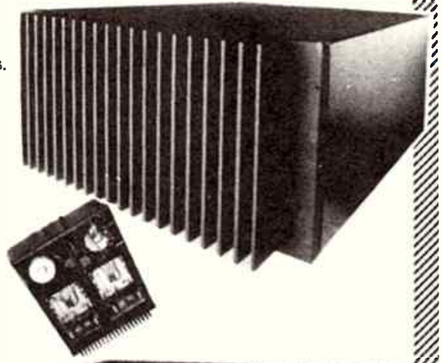
SAVE $15.50
ONLY $39.50

SALE SALE SALE SALE SALE SALE SALE SALE SALE SALE SALE SALE SALE

THE ULTIMATE PERFECT PARTNERS

AEM 6000 POWER AMPLIFIER

By David Tillbrook. This superb power amplifier has an output of 240 watts rms into 8 ohms or a massive 360 watts rms into 4 ohms. The Jaycar kit includes all parts including 300VA toroidal transformer.
Cat. KM-3020



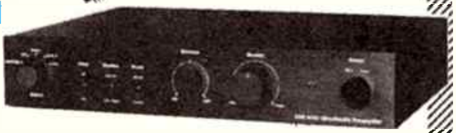
"ULTRA FIDELITY" PREAMPLIFIER

REF: AEM OCT - DEC 1985
Cat. KM-3030

Power Amp	$998
Pre Amp	$359
	$1357

APRIL BARGAIN

BUY BOTH FOR ONLY $1257 SAVE $100



PLAYMASTER 60/60 STEREO AMPLIFIER

WITH AUSTRALIAN MADE TRANSFORMER

High quality, low priced stereo amplifier. See EA May/June/July 1986.
Cat. KA-1650

MORE POWER!!

$299

DUAL TRACKING POWER SUPPLY

Ref: EA Feb 1987
Will supply up to ±21.5V at 500mA. At 5V it will supply 3A and at 10-16V 2 amp.
Cat. KA-1682

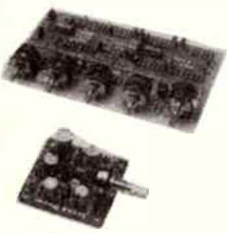
$129.50

3 BAND SHORTWAVE RADIO

Great for budding SWL or amateurs.
This kit will tune from 0.48MHz thru to 17MHz! The project features high sensitivity, one IC in the RF section and high performance at a low, low cost. Battery operated.
Cat. KA-1681

Ref: EA January 1987

ONLY $79.50



BI-FET PREAMP

Pre-built unit - superb specs.
Cat. AA-0315

ONLY $69.95

6 WATT MICRO AMP 1 CHANNEL

amplifier your Walkman.
Cat. AA-0340

ONLY $13.95

NEW GENERATION CORDLESS PHONE

MICROPROCESSOR CONTROLLED - 200 METRES RANGE AND ABSOLUTE SECURITY

Quite simply the finest cordless phone we have appraised. Naturally it is in total conformity to the 1986 Telecom specifications and is Telecom approved.
The range with the 39/30MHz RX/TX FM system is fabulous - as against the very short range of cordless phones of yesteryear.

FEATURES:
- Operating range up to 750ft (250m)
- Security code system with 16,384 combinations
- Last number redial
- LED indicator on handset for low battery indication
- Hearing aid compatible

Cat. YT-7065

$269

PLACE YOUR MAIL ORDERS BY FACSIMILE

(02) 744 0767

LOW DISTORTION AUDIO OSCILLATOR

See EA December 1986
Unmetered version
Cat. KA-1680

$139.00

ELECTRIC FENCE KITS

HIGH POWER

Ref: EA October 1986
The ultimate electric fence. Will power fence runs up to 1km+ and still pack a punch. Low output impedance overcomes wet grass, poor insulation, etc.
12V powered. The Jaycar kit contains all parts.
Cat. KA-1678

NORMALLY $229
SAVE $30.00
ONLY $199

"ELECTRIC FENCE"

Mains or battery powered. Kit does not include automotive ignition coil. Adequate deterrent for all manner of livestock.
Cat. KA-1109
Ref: EA
Sept 1982

$21.50

ELECTRIC FENCE CONTROLLER

Ref: EA December 1985
NEEDS NO AUTO COIL!
Uses special output transformer so it is more likely to work into false loads. It has low current drain coupled with higher performance. The Jaycar kit is supplied with all parts including a length of HT cable and heavy HT connecting clip.
Cat. KA-1660

$49.95

GORE HILL OPEN SATURDAY UNTIL 4pm

Letters to the Editor

Kit advice

AS AN AMATEUR radio operator I found the ETI-1533 heavy duty switching regulator (Nov/Dec '86) to be potentially a very useful project. Unfortunately all the kit suppliers I have tried so far in Victoria, NSE and WA have elected not to do it.

The bulk of the project I already have including ratting out a TDK PQ 35-35 inductor. The trouble is obtaining the pcb. My query is: could you please tell me who might be stocking this pcb, at least. Surely someone must have ordered the artwork to make a board. I am sorry that Ian Thomas went to all the trouble of designing and building the project and ETI running it especially in two parts, then to get the thumbs down from the kit suppliers. I guess the problem gets back into that argument of complete kit and cost of them vs separate component availability.

If suppliers at least handled the pcbs then the many like me who have much of the hardware would subsequently go on to build the kit.

I would certainly support the argument of kit suppliers supplying short form kits, eg, pcb and semiconductors, as well as complete kits instead of suppliers always making available only long-form (complete) kits.

Dr Ross Wines
East Doncaster, Vic

The pcb for this project is available from RCS, contactable (02) 759-5673. A complete list of kits and their suppliers is included in the January '87 Yearbook issue of ETI.

Seconding the motion

I AM IN the process of building up the ETI-684 modem as published in your magazine during 1986. My main problem is that there is no supplier in New Zealand for a complete kit of components or for the 2764 EPROM used in the design of the modem.

I have put some thought into this matter and it seems that some people have a disadvantage in building up your projects, not only in New Zealand but also in Australia. That is the large market of people not wanting to purchase the complete kit but rather a shortform kit (ie the printed circuit board/s plus the semiconductors and special components required for the project). This form of kit set was once very popular in NZ and several companies did very good business out of them.

Perhaps some of the companies that sell the kits in Australia could offer this from along with the full kit sets to help promote their sales. I know from my own experience that tracking down of special components is a long and often frustrating pastime and that if I could purchase the shortform of a kit I would rather do that than waste my time on the phone.

Grant Rogerson
Trentham, NZ

Whether a weather station

I AM A SUBSCRIBER to ETI, and have been so for some years. I also have had a passing interest in the weather (like most people I know).

Unfortunately, I know little — actually nothing — about electronics, and I was wondering whether you, your project engineers or your readers could help me — by providing a circiut, kit or some other electronic method for recording the basic elements of weather, such as temperature, and maybe even adding humidity and air pressure.

With such a kit, and a (simple)? interface with a computer — a Microbee preferably — each home could become a mini weather station, providing useful data, with the possibility of providing better information on local conditions than the weather bureau can provide. (This at times, would not be hard!) It would be great if such a device could work 'stand-alone', either with a daily or weekly transfer of data to the home computer.

Further, an amateur network of weather stations could develop, thus providing the basis for a huge database of information which would enable the experts to provide accurate forecasts (or is this an unobtainable dream?). Hot on the trail of your Weather Catastrophe article (ETI Feb) I feel that such a kit could give us warning ... of the inevitable!

Raymond Brooks,
Warrimoo, NSW

We would be happy to run a project for a weather station. Anyone with ideas should get in touch with me.

— Ed.

The great kit offensive

APPROXIMATELY ONE MONTH ago I ordered an ETI-5000 power amplifier kit from one of the major kit suppliers.

This project was received with the following faults:

1. Base slightly dented due to transformer weight and bad packaging.
2. Lid badly dented and paint flaky for same reason.
3. Only three BF470 transistors supplied (eight required).
4. Two 47R resistors not supplied at all.
5. Eight 270k resistors supplied instead of 270R.
6. 56R resistors substituted for 47R; in my opinion this is not a suitable alternative.

The company has twice been contacted concerning these faults but to date has not rectified the problem. My project has now been held up for a month.

This standard of kit make-up service is bloody abysmal.

Nicholas Potter
Dickson, ACT

MSX v IBM

WHAT IS MSX? The MSX story is almost unbelievable. It started about two years ago and all the popular computer magazines in Australia ignored it. They stand accused of pandering to their principal advertizers without showing any responsibility or regard for their readers. Strong stuff? Judge for yourself ...

The following well-known computer manufacturers combined to produce inexpensive home computers which would be totally compatible with one another. Both software and hardware would be interchangeable. It was to be the new generation of home PCs. The companies were Canon, Goldstar, JVC, Mitsubishi, Panasonic, Pioneer, Sanyo, Sony, Spectrovideo, Toshiba and Yamaha. An impressive list.

The BASIC was written by Microsoft. The CPU is the well-known Z-80A. Emphasis was made to sound, sprites and colour. The sound channels alone are a most impressive eight-octave, three-channel polyphonic. It has everything the reviewers had been asking for, and more.

MSX magazines from Britain carry advertisements from major program houses. Their programs are available in chain-stores such as Woolworths, Boots and others. The programs are on disk, cassette, cartridge and card. Have we

read about the MSX system in your magazine? All we get is IBM, IBM-clones, IBM-compatibles, IBM this and IBM that. Your readers have every reason to feel cheated.

Your readers should be interested in knowing that MSX is the most logical progression from the VZ-200/300. Printers, plotters, data recorders and more importantly, their hard-earned knowledge can all be carried forward to the MSX system.

Cost? Well, get this? The Sony HB-75AS which has in-built printer and recorder interfaces, and has three in-built personal data programs, not to mention both VHF and RGB outputs, is only $399.

If your policy includes service to your readers then why not feature a review of the Sony? It might just revive a flagging interest in home computers.

Gordon A. Browell
Biggenden, Qld

Sparks from an electrician

I AM WRITING to you to comment on a statement made by Ian Thomas (ETI, December 1986, p 46).

The comment was, and I quote, "I most vigorously recommend using a double-pole mains switch as I have absolutly no faith whatever in the electricians switching the active in the power point".

Now I don't know about the electricians in Australia, but here in New Zealand, we have to train for four years to become registered as an electrician, and in those four years you learn how to wire up a power point in the first month.

Also here in New Zealand, we have very strict regulations on testing the instalation before livening occurs.

I enjoy reading your magazine and look forward to another good year of reading.

B. K. Edney
Wellington, NZ

Cable Sceptic

AS A LONG time reader of ETI, I would like to congratulate you and the staff of ETI for the very high standard of the magazine throughout the year and for the great projects and feature articles. I know that there are a lot more coming and I look forward to them with anticipation.

I was intrigued by the article on audio cables by Louis Challis in the December issue, for the reason, as much as anything else, that I was (and still am) one of the sceptics as to the value of so-called 'super cables'. That is not to say that I do not agree with the stated merits of a high damping factor in amplifier-speaker systems but I cannot see how a cable resistance of a fraction of an ohm can have any significant effect (on damping) on a speaker system having a resistive component of impedance of many times that. If it were so, could not a speaker system manufacturer allow for that by reducing the effective series resistance of any given system by a small (and specified) amount, leaving all other parameters the same, and thereby achieving the same results as (claimed) for the super cables?

If small values of cable (and connector) resistances have such an adverse effect as claimed by some, then I wonder why hi-fi amplifier designers have not (or have they?) used a technique known as 'remote feedback'? The concept is well known in instrumentation and remote sensing applications where the effects of cable resistance (etc) have to be minimized.

Herman Nacinovich
Gulgong, NSW

```
2 OPEN4,4
3 DIMA(40),B$(40),C$(40),D(40),E(40)
5 Y=2:X=0
6 PRINT""
10 B=53280 POKEB,9:POKEB+1,9:PRINT""
11 PRINT""
12 PRINT"DIRECTION CRSR KEYS"
13 PRINT"WRITE  F1"
14 PRINT"ERASE  BACK TRACK WITH CRSR KEYS"
15 PRINT"END PPOO F5"
16 PRINT"PRINTER F7":PRINT""
30 FORT=80TO359:POKE1024+T,87:POKE55296+T,7:NEXT
40 GETA$:IFA$=""THEN40
42 IFA$=""THENEND
50 IFA$=""THEN Y=Y-1:GOTO70
52 IFA$=""THEN Y=Y+1:GOTO70
54 IFA$=""THEN X=X+1:GOTO70
56 IFA$=""THEN X=X-1:GOTO70
58 IFA$=""THEN GOSUB100
60 IFA$=""THEN GOSUB200
62 IFA$=""THEN GOSUB301
[illegible]
[illegible]
71 IFY[illegible]THENY=8
72 IFX[illegible]THEN[illegible]=0
[illegible]
75 POKE1024+X+40*Y,87:POKE55296+X+40*Y,6
76 POKE55296+X+40*Y,7
77 GOTO40
100 P=1024:C=55296
102 POKE1024+X+40*Y,42:POKE55296+X+40*Y,0
104 RETURN
[illegible]
[illegible]
[illegible]
301 FOR[illegible]=0TO39
302 FORY=8TO2STEP-1
304 [illegible]=PEEK(1024+[illegible]+40*Y)
305 [illegible]THENB$="1"
306 [illegible]THENB$="0"
[illegible]
```

Bit image drawer

Have you ever tried to design your own characters for the MPS 803 printer only to receive a mess of dots as your final product?

Well this program eliminates the chances of this. All you have to do is plot out your character on the screen using the cursor keys for movement and the *F1* key to draw. When you are satisfied with your design just press *F7* and your character is printed out. (Don't forget to turn it on or your design will be lost!)

J. Vella
Tregear, NSW

```
00100 REM BY JOHN LIVINGSTON 11/06/86
00110 REM ###### B O M B S ######
00120 H=3:N1$="COMPUTER"
00130 DATA 255,126,60,60,255,126,126,60,60,60,60,60,60,60,24,24
00140 DATA 0,0,0,128,128,128,192,192,224,240,248,252,255,255,255,255
00150 DATA 0,0,0,0,0,0,0,0,0,0,0,0,0,255,255,255,255
00160 DATA 0,0,0,1,1,1,3,3,7,15,31,63,255,255,255,255
00170 DATA 1,1,3,3,11,11,47,47,39,191,191,255,255,255,255,255
00180 DATA 128,128,192,202,204,216,240,240,240,240,249,250,250,252,255,255
00190 K=15:J=30:R=0
00200 S=INT(RND#59)+2
00210 FORM=64528TO64528+90
00220 READD:POKE M,D:NEXTM
00230 CLS:NORMAL:PRINT"### INSTRUCTIONS ###"
00240 PRINT"MISSILES ("H:PCG:PRINT"A"H:NORMAL:PRINT") ARE FALLING TO EARTH.
    YOU MUST SAVE YOUR PLANET YOUMUST DESTROY THESE MISSILES."
00250 PRINT"TO DO THIS YOU MUST BLOCK IT'S PATH AND MAKE IT CRASH ON YOUR
    DEFLECTOR-"H:PCG:PRINT"BCCD"H:NORMAL:PRINT"TO MANOUVRE YOUR DEFLECTOR USE
    THE < > KEYS FOR SLOW MOVING &"
00260 PRINT"YOUR   Z  X  KEYS FOR FAST MOVING. IF YOU'RE STRUCK TEN TIMES BY
    A BOMB YOU AND YOUR PLANET EARTH ARE DESTROYED. POINTS ARE "
00270 PRINT"AWARDED FOR EVERY BOMB YOU DEFLECT."\"!!!GOOD LUCK DEFENDING
    EARTH!!!"\"PRESS ANY KEY"
00280 FOR X=1 TO 1024:IF KEY<>""THEN 320 ELSE OUT 2,X:OUT 2,0:NEXT X
00290 S3$=KEY
00300 IF S3$=" "THEN 320
00310 IFS3$=""THEN 290
00320 CLS:PRINT"!!!!!! GET READY. INCOMING BOMBS !!!!!!":FOR K4=1TO2000:NEXTK4
00330 S=S+2
00340 PCG:R=0
00350 S=INT(RND#62)+1
00360 CLS:CURS J,K:PRINT"B":CURS J+1,K:PRINT"C":CURS J+2,K:PRINT"C":CURS
    J+3,K:PRINT"D"
00370 R=R+1: CURS S,R:PRINT"A"
00380 A=PEEK(258):IFA=44 THEN LET J=J-2
00390 IFA=26 THEN LET J=J-4
00400 IFJ<1THEN LETJ=1
00410 IF J=S AND K=R THEN GOTO 500
00420 IF K=R AND J+1=STHEN: GOTO 500
00430 IFK=R AND J+2=S THEN GOTO 500
00440 IFK=R AND J+3=S THEN GOTO 500
00450 IF R=15 THEN GOTO 550
00460 IFA=46 THEN LET J=J+2
00470 IFA=24 THEN LET J=J+4
00480 IFJ>61 THEN LET J=59
00490 GOTO 360
00500 CURS S,R:PRINT"EF":B=B+1
00510 NORMAL:CURS 1,1:PRINT"MISSILES DESTROYED  "B:CURS 30,1:PRINT"MISSILES
    HIT EARTH  "N:PCG
00520 FORI=1 TO 100:OUT 2,125:OUT 2,24:NEXTI
00530 FORW=1TO1000:NEXTW
00540 GOTO 340
00550 CURS S,R:PRINT"EF":N=N+1
00560 NORMAL:CURS 1,1:PRINT"MISSILES DESTROYED  "B:CURS 30,1:PRINT"MISSILES
    HIT EARTH  "N:PCG
00570 FORI=1 TO 100:OUT 2,125:OUT 2,0:NEXTI
00580 U=U+1:IFU=10 THEN 610
00590 FORW=1TO1000:NEXTW
00600 GOTO 340
00610 CLS:NORMAL:PRINT"YOUR SCORE WAS"B:IFB>H THEN 620 ELSE GOTO 650
00620 LETH=B:GOTO 640
00630 FORD4=1TO2000:NEXTD4:GOTO 640
00640 PRINT"YOU HAVE MADE A NEW HIGHEST SCORE."\"YOUR NAME IS":INPUT N1$
00650 FORJ=1TO1000:NEXTJ
00660 J=0
00670 LETP=H
00680 CLS:PRINTN1$" HAS THE HIGHEST SCORE OF ":H
00690 LETO=0:LETN=0:U=0
00700 J=30
00710 PRINT\\\\"DO YOU WISH TO SAVE THE EARTH AGAIN Y/N "
00720 INPUT B2$
00730 IFB2$="Y"THEN 320
00740 IFB2$="y"THEN 320
00750 IFB2$=""THEN 720
00760 IFB2$<>"Y"THEN END
```

Bomb deflector

The aim of this simple game for the Microbee is for the player to deflect falling bombs using a deflector shield. To move the shield quickly press: *Z* for left, *X* for right, and for slow alterations press < for left and > for right. You are awarded a point for every missile you deflect. If you miss 10 missiles then the game is over.

J. Livingstone
Townsville, Qld

```
  5 POKE53280,4:POKE53281,4:PRINTCHR$(144)
 10 PRINTCHR$(147):PRINT
 20 PRINTSPC(13)"\":PRINTSPC(12)"\\\\"
 30 PRINTSPC(10)"/\  \/  "
 40 PRINTSPC(10)"\/\   "
 50 PRINTSPC(8)"/¯¯L\     (RVON)   (C/RT) (C/RT) (RVOF)"
 60 PRINTSPC(8)"\/       (RVON) (C/RT)(C/RT)(C/RT) (C/RT) (RVOF)"
 70 PRINTSPC(6)"/¯¯\       (RVON)   (C/RT)   (RVOF)"
 80 PRINTSPC(6)"\  /      (RVON) (C/RT) (C/RT)(C/RT)(C/RT) (RVOF)"
 90 PRINTSPC(7)"\/       (RVON)   (C/RT)(C/RT)(C/RT) (RVOF)"
100 PRINTSPC(14)"(C/DN)(C/DN)(C/DN)(C/DN)(C/DN)PRESS A KEY!"
110 GETA$:IFA$=""THEN110
120 PRINT"(CLR)"
130 POKE53280,0:POKE53281,0
140 X=1524:T=0:C=1
150 A=PEEK(56320):B=PEEK(197)
155 IFA=122THENX=X-41:POKEX,160:T=0
160 IFA=123THENX=X-1:POKEX,160:T=0
165 IFA=117THENX=X+41:POKEX,160:T=0
170 IFA=119THENX=X+1:POKEX,160:T=0
175 IFA=121THENX=X+39:POKEX,160:T=0
180 IFA=126THENX=X-40:POKEX,160:T=0
185 IFA=118THENX=X-39:POKEX,160:T=0
190 IFA=125THENX=X+40:POKEX,160:T=0
200 IFA=107THENT=1:GOTO400
210 IFA=103THENT=1:GOTO430
220 IFA=110THENT=1:GOTO460
230 IFA=109THENT=1:GOTO490
235 IFB=57THENC=1
240 IFB=56THENC=2
245 IFB=32THENC=12
250 IFB=59THENC=3
255 IFB=35THENC=11
260 IFB=8THENC=4
265 IFB=40THENC=10
270 IFB=11THENC=5
275 IFB=43THENC=13
280 IFB=16THENC=6
285 IFB=48THENC=14
290 IFB=19THENC=7
300 IFB=24THENC=8
310 IFB=27THENC=9
320 IFB=0THENPOKEX,32
330 IFB=51THEN120
340 IFX=1067THEN520
360 IFX>=1984THEN550
370 Z=X+54272:POKEZ,C
390 GOTO150
400 IFT=1THENPOKEX,32
410 X=X-1:POKEX,160
420 GOTO240
430 IFT=1THENPOKEX,32
440 X=X+1:POKEX,160
450 GOTO240
460 IFT=1THENPOKEX,32
470 X=X-40:POKEX,160
480 GOTO240
490 IFT=1THENPOKEX,32
500 X=X+40:POKEX,160
510 GOTO240
520 IFT=0THENX=X+960:POKEX,160
530 IFT=1THENPOKEX,160:X=X+960
540 GOTO360
550 IFT=0THENX=X-960:POKEX,160
```

Draw 64

This is a drawing program which is controlled by the joystick in port 2, and the top row of the keyboard. Pressing the 'fire' button and required direction will move the cursor around the screen. The *INST/DEL* key will delete at the current cursor position, and the *CLR/HOME* key will clear the screen. The remaining keys in the top row changes the colours.

J. Avis,
Frenchs Forest, NSW

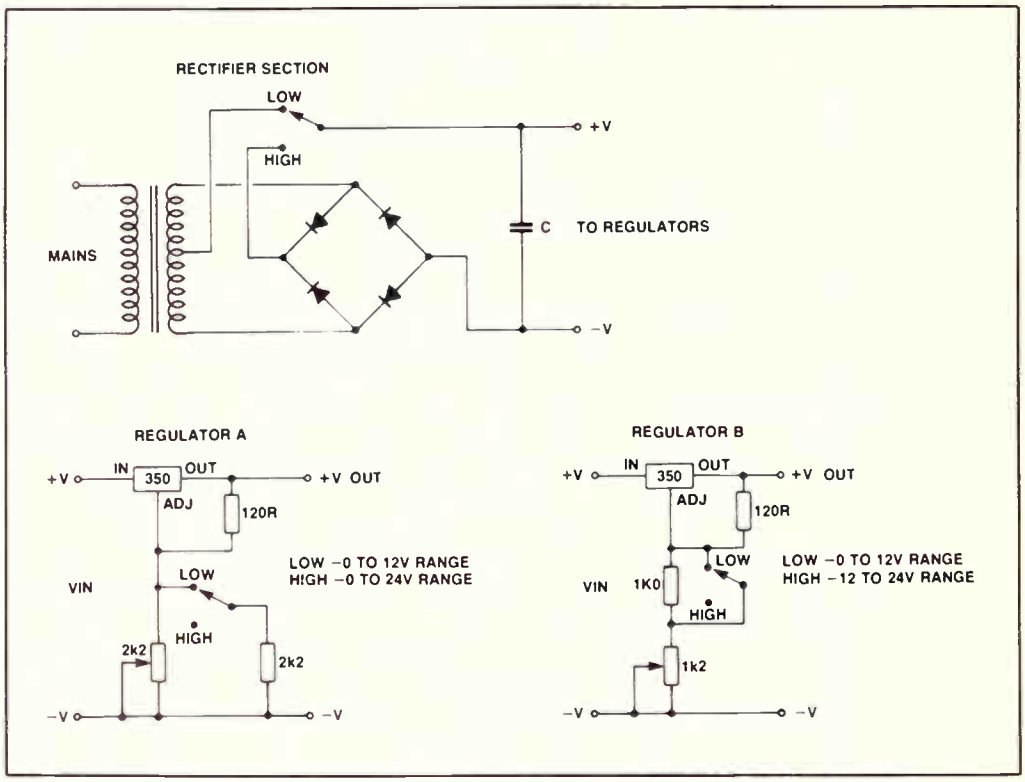
```
00100 CLS:CURS 18,6:UNDERLINE:PRINT"Budget Savings Account":NORMAL:PLAY 0,20
00110 REM ### 1984 by D.R.Barney ###
00120 REM ### EDMONTON QLD. ###
00130 N10="B ACCT":E70="       "
00140 DIM C0(10),N0(7)
00150 B10="Car Registration":B20="Car Insurance":B30="Life Assurance No. 1":B40=
"Life Assurance No. 2":B50="Contents Insurance"
00160 B60="Electricity":B70="Telephone":B80="Car Tyres & Maintenance":U10="Savin
gs"
00170 CLS:CURS 450:INPUT"Enter today's date DD,MM,YYYY ?";D,O,Y
00180 CLS
00190 PRINT\\\"Do you wish to enter data off tape  (Y/N) ";
00200 B10=KEY:IF B10="" THEN 200
00210 IF B10="Y" OR B10="y" THEN GOSUB 1290 ELSE GOTO 240
00220 GOTO 550
00230 REM ### Enter amounts via keyboard ###
00240 CLS
00250 INPUT"Enter Total Amount in Account:";C0(1)
00260 CLS:REM ### Transfer amounts use negative to subtract, positive to add ###

00270 UNDERLINE:PRINT"Amount in Acct":NORMAL:CURS 29:UNDERLINE:PRINT"Item":NORMA
L:CURS 471UNDERLINE:PRINT"Amount Entered":NORMAL:PRINT
00280 PRINT USING"#####.##";C0(2);K2
00290 PRINT"Enter Savings Amount.........:";:INPUT;K2
00300 C0(2)=C0(2)+K2
00310 PRINT USING"#####.##";C0(3);K3
00320 PRINT B10"..............:";:INPUT;K3
00330 C0(3)=C0(3)+K3
00340 PRINT USING"#####.##";C0(4);K4
00350 PRINT B20"..............:";:INPUT;K4
00360 C0(4)=C0(4)+K4
00370 PRINT USING"#####.##";C0(5);K5
00380 PRINT B30"..........:";:INPUT;K5
00390 C0(5)=C0(5)+K5
00400 PRINT USING"#####.##";C0(10);E1
00410 PRINT B40"..........:";:INPUT;E1
00420 C0(10)=C0(10)+E1
00430 PRINT USING"#####.##";C0(6);K6
00440 PRINT B50"...........:";:INPUT;K6
00450 C0(6)=C0(6)+K6
00460 PRINT USING"#####.##";C0(7);K7
00470 PRINT B60"...................:";:INPUT;K7
00480 C0(7)=C0(7)+K7
00490 PRINT USING"#####.##";C0(8);K8
00500 PRINT B70"....................:";:INPUT;K8
00510 C0(8)=C0(8)+K8
00520 PRINT USING"#####.##";C0(9);K1
00530 PRINT B80"......:";:INPUT;K1
00540 C0(9)=C0(9)+K1
00550 CLS
00560 IF C0(1)<>C0(2)+C0(3)+C0(4)+C0(5)+C0(9)+C0(7)+C0(8)+C0(6)+C0(10) THEN PRIN
T"DOESN'T BALANCE":PLAY8,20:GOTO 100
00570 GOTO 740
00580 REM ### Deposit routine ###
00590 CLS:PRINT"Are Deposits to be added to Savings only?"
00600 Q10=KEY:IF Q10="" THEN 600
00610 IF Q10="Y" OR Q10="y" THEN 1050
00620 M0=N0(0):M1=N0(1):M3=N0(2):M2=N0(3):M4=N0(7):M5=N0(5):M6=N0(6):M7=N0(4)
00630 PRINT"Enter Amount Deposited for distribution.....:";
00640 INPUT A2
00650 IF A2<M0+M1+M2+M3+M4+M5+M6+M7:A=2:PRINT"Amount entered is too small to dis
tribute as required.":GOTO 750
00660 A4=A4+A4
00670 C0(1)=C0(1)+A2
00680 A4=A2-M0-M1-M3-M2-M4-M5-M6-M7
00690 C0(2)=A4+C0(2)
00700 C0(10)=C0(10)+M0:C0(3)=C0(3)+M1:C0(4)=C0(4)+M3:C0(5)=C0(5)+M2:C0(9)=C0(9)+
M4:C0(7)=C0(7)+M5:C0(8)=C0(8)+M6:C0(6)=C0(6)+M7
00710 CLS:REM ### Display routine ###
00720 IF D=1 THEN OUT#1
00730 IF D=1 THEN PRINT\\\
00740 PRINT"Date "I0I"."I0I"."IYI
00750 PRINT B10"..........";USING"#####.##";C0(3):PRINT\B20"..............";USI
NG"#####.##";C0(4):PRINT\B30"..............";USING"#####.##";C0(5):PRINT\B40"..
.....";USING"#####.##";C0(10)
00760 PRINT B50".........";USING"#####.##";C0(6):PRINT\B60"..............";USI
NG"#####.##";C0(7):PRINT\B70"..................";USING"#####.##";C0(8)
00770 PRINT B80"...";USING"#####.##";C0(9)
00780 PRINT U10" Balance.............";USING"#####.##";C0(2):PRINT\TAB(26 32)TAB(10 45)\"TOTAL BALA
NCE              ";USING"#####.##";C0(1)
00790 PRINT TAB(26 32)TAB(10 61)
00800 IF D=1 THEN PRINT\\\\\\\\\\\\\\\\
00810 OUT#0:D=0
00820 PRINT"Press any key to Continue"
00830 K10=KEY:IF K10="" THEN 830
00840 CLS
00850 PRINT"Type 1 to Transfer amounts within Account"
00860 PRINT"Type 2 to Deposit money into Account"
00870 PRINT"Type 3 to Withdraw money from Account"
00880 PRINT"Type 4 to Save Data on tape"
00890 PRINT"Type 5 to Alter Item Amounts"
00900 PRINT"Type 6 to Dump Display to Printer"
00910 PRINT"Type 7 to Return to Display"
00920 PRINT"Type 8 to End"
00930 Z=0:GOSUB 1610
00940 ON X GOTO 260,590,980,950,1520,1650,710,1080
00950 GOSUB 1180
00960 GOTO 710
00970 REM ### Withdrawl routine ###
00980 CLS:PRINT"Where is the amount to be withdrawn from?"
00990 GOSUB 1660
01000 PRINT U10"..................Type 9"
01010 Z=9:GOSUB 1610
01020 CURS 704:PRINT"Enter Amount to be withdrawn from "IZ7O;
01030 ON X GOSUB 1090,1100,1110,1170,1120,1130,1140,1150,1160
01040 GOTO 710
01050 PRINT"Enter Amount Deposited.....:";:INPUT A2
01060 C0(2)=C0(2)+A2:C0(1)=C0(1)+A2
01070 GOTO 710
01080 CLS:END
01090 INPUT B1:C0(3)=C0(3)-B1:C0(1)=C0(1)-B1:RETURN
01100 INPUT B3:C0(4)=C0(4)-B3:C0(1)=C0(1)-B3:RETURN
01110 INPUT B2:C0(5)=C0(5)-B2:C0(1)=C0(1)-B2:RETURN
01120 INPUT B4:C0(6)=C0(6)-B4:C0(1)=C0(1)-B4:RETURN
01130 INPUT B5:C0(7)=C0(7)-B5:C0(1)=C0(1)-B5:RETURN
01140 INPUT B6:C0(8)=C0(8)-B6:C0(1)=C0(1)-B6:RETURN
01150 INPUT B7:C0(9)=C0(9)-B7:C0(1)=C0(1)-B7:RETURN
01160 INPUT B0:C0(2)=C0(2)-B0:C0(1)=C0(1)-B0:RETURN
01170 INPUT E4:C0(10)=C0(10)-E4:C0(1)=C0(1)-E4:RETURN
01180 GOSUB 1390
01190 POKE 61440,13
01200 OUT#3
01210 PRINT"*****";CHR$ 13;N10
01220 PRINT[15 13]",";
01230 PRINT C0(1)",";C0(2)",";C0(3)",";C0(4)",";C0(5)",";C0(6)",";C0(7)",
";C0(8)",";C0(9)",";C0(10)
01240 PRINT N0(0)",";N0(1)",";N0(2)",";N0(3)",";N0(4)",";N0(5)",";N0(6)",
";N0(7)
01250 POKE 61439,9
01260 PRINT"0,0,0,0,0,0,0,0"
01270 OUT#0:PLAY 23,4
01280 RETURN
01290 GOSUB 1390
01300 IN#3:OUT#0 OFF
01310 INPUT Z0$:IF Z0$(11,5)<>"*****"THEN 1310
01320 N10=Z0$(11,16):R=1:R=INT(VAL(Z0$(16,18))):POKE 61440,13
01330 INPUT Z0$,C0(1),C0(2),C0(3),C0(4),C0(5),C0(6),C0(7),C0(8),C0(9),C0(10)
01340 INPUT N0(0),N0(1),N0(2),N0(3),N0(4),N0(5),N0(6),N0(7)
01350 IF INT(VAL(Z0$))<>1 THEN 1300
01360 POKE 61439,9:IN#0:OUT#0
01370 CLS:PRINT N10:PLAY 9:RETURN
01300 IN#0:OUT#0:CURS 1,16:PRINT"BAD LOAD":PLAY 9:RETURN
01390 CLS
01400 CURS 470:INVERSE:PRINT" TAPE READY? ":NORMAL:CURS700:PRINT"Press any key t
o continue";
01410 Z6$=KEY:IF Z6$="" THEN 1410 ELSE CLS:RETURN
01420 REM ################ @@@@@@@@@@@@@@@@ ################
01430 CLS
01440 CURS 20:INVERSE:PRINT" Alter Amounts of Items ":NORMAL
01450 PRINT\"Where is the item to be altered?"
01460 GOSUB 1660
01470 Z=8:GOSUB 1610
01480 CURS 768:PRINT"Enter Item to be altered "IZ7O;
01490 IF X>4:X=X-4
01500 IF X>4:X=X-1
01510 INPUT N0(X);
01520 M0=N0(0):M1=N0(1):M3=N0(2):M2=N0(3):M4=N0(7):M5=N0(5):M6=N0(6):M7=N0(4)
01530 REM ### Amounts for deduction  ###
01540 CLS:PRINT"Each item is set to deduct the amount as listed below :-"\
01550 PRINT B10"          "USING"#####.##";M1\B20"          "USING"#####.##";M3\B30"    "USI
NG"#####.##";M2\B40"    "USING"#####.##";M0
01560 PRINT B50"       "USING"#####.##";M7\B60"              "USING"#####.##";M5\B70"
    "USING"#####.##";M6
01570 PRINT B80" "USING"#####.##";M4
01580 PRINT"Do you wish to alter any items? Y/N";
01590 Z10=KEY:IF Z10="" THEN 1590
01600 IF Z10="y"ORZ10="Y"THEN 1420 ELSE 710
01610 REM ##### Select Option #####
01620 CURS 960:PRINT"Select Option (1 to"IZ")";
01630 Z70=KEY:IF Z70="" THEN 1630 ELSE LET X=INT(VAL(Z70))
01640 IF X <1 OR X>Z THEN 1630 ELSE RETURN
01650 D=1:GOTO 710:REM ### Dump to printer ###
01660 PRINT\ B10"..........Type 1"
01670 PRINT B20"..............Type 2"
01680 PRINT B30"........Type 3"
01690 PRINT B40"........Type 4"
01700 PRINT B50"..........Type 5"
01710 PRINT B60"..................Type 6"
01720 PRINT B70"..................Type 7"
01730 PRINT B00"....Type 8"
01740 RETURN
```

Budget savings account

This program for the Microbee helps to keep track of your savings and is useful for checking your balances with your bank statements. The program deducts amounts for the various budget items and keeps a balance of each item. A net balance is given to compare with your bank statement. Amounts can be transferred within the account and item deduction can be changed (for inflation).

D. R. Barney
Edmonton, Qld



Efficient power supply

If you want an adjustable power supply capable of delivering a fairly high voltage at a reasonable current, it is impractical to use it at a low voltage if a large current is drawn. An enormous amount of heat would be dissipated in the regulator (assuming a series pass one is used). Thus a second power supply is needed.

If the transformer used is a centre-tapped one, the following circuit can be used to give the appearance of two power supplies, with a minimum of extra components (a switch and two resistors).

A four-diode bridge is used, so that when the switch is in the 'high' setting the rectifier gives the full transformer voltage, but when it is set on 'low' it only produces half that voltage as a centre-tapped circuit is used.

If the switch is DPDT it can also be used in the regulator section to choose the required voltage. I have included two simple examples using different approaches based on the 350 three-terminal adjustable 3A series regulator.

Both A and B are used with a 12-0-12 V transformer, and provide 0-12 V when the switch is in the 'low' setting. These values can easily be changed by altering the values of the resistors.

When the switch is in the 'high' position, regulator A provides a range of 0-24 V, and regulator B provides a range of 12-24 V, giving finer adjustment.

I have used a power supply based on this principle for the past year, and I have found it exceedingly useful.

A. Conway
Doncaster, Vic

Minimart

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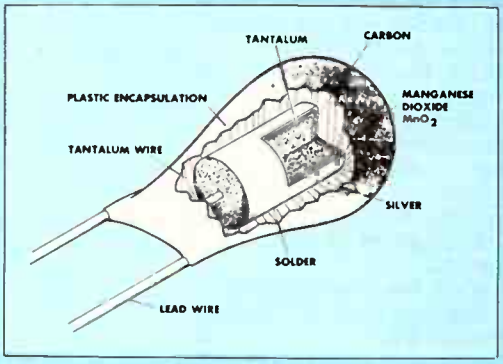

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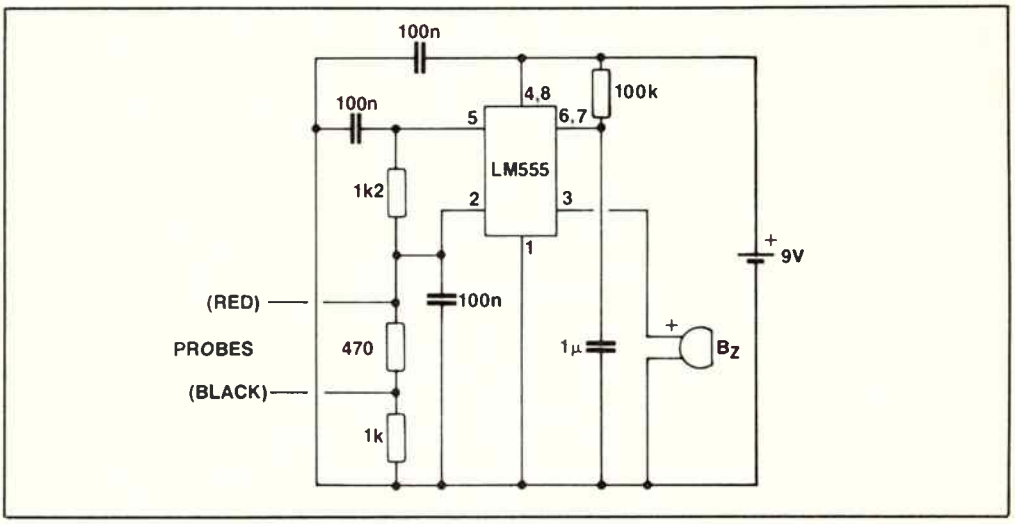
ADVERTISING INFO No. 14

Idea of the Month

A safe buzzer



One of the most useful tools in the electronics technician's toolbox consists of a battery and a buzzer in series, perhaps built into the case of a discarded torch, wired up to a pair of probes or clips. This is fine for checking wiring but cannot be used safely for tracing semiconductor circuits because of the voltage needed.

Apart from the possibility of actual damage to sensitive components, there is the real likelihood of a semiconductor junction being mistaken for a connection or short-circuit. Also there is a problem in the slow response of the buzzer: a good connection must be made for at least 100 ms (approx) to get any response. This may not sound much, but in practice can lead to missing a vital identification when you're checking out a 50-pair cable or multi-pin connector.

This design overcomes all these difficulties: it will indicate for connections less than 500 ohm, presents about 700 mV to the circuit under test and requires contact for about 1 ms to give a short buzz.

The 100k/1µ combination determines the minimum buzz time. The buzzer used was a miniature 6-12 V electronic type (eg, Sonalert). Values in the series resistor chain should be adhered to but 100n capacitors are not critical, serving only to prevent false triggering.

D. Butler
Oaklands Park, SA

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.

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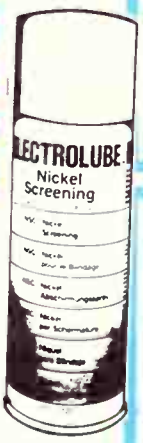

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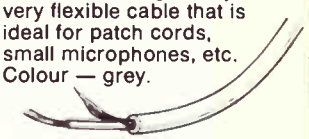

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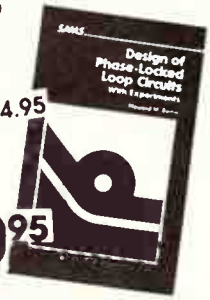

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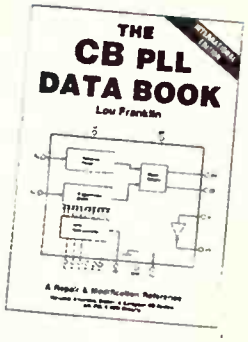

A mine of information for the avid CB'er. Contains details on the phase locked loops used in just about every CB ever made. So what? It also tells you how to modify the PLL circuitry to give more channels, to push it, repair it, to do just about anything except talk. (They're working on that one!) And if you repair CB's, this is indispensable for the technical data it gives — data you won't find anywhere else.
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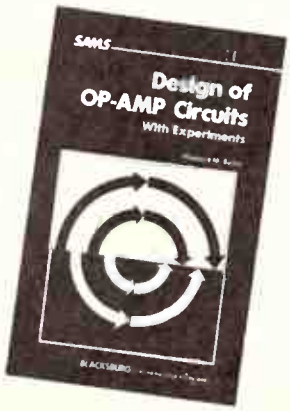
Was $8.95 **$4.47**

Design of OP-AMP Circuits With Experiments



This is your opportunity to learn about the most versatile integrated circuit today: the Op-Amp. Renowned author, Howard M. Berlin, teaches you how to distinguish one type of op-amp from the other, about the use of op-amps in basic linear amp circuits, their use in active filters and more! Over 220 pages of information. Cat B-1251

Was $22.95 **$16.96**

Transistor Equivalents

This reference book enables the user to find substitutes for approximately 9,500 European, American and Japanese transistors. Cat B-4507

Was $4.95 **$3**

Laser Technology

Interested in laser technology? This informative source book has been written for hobbyists and technicians. Covers laser radiation, construction, design and much, much more. Cat B-1861

Was $12.95 **$8**

Australian CB Radio Handbook

A complete guide to CB Radio including latest marine radio service details. Which system is best? What is the range of CB? What type should you buy? How to conduct yourself on air. The latest edition includes the new regulations and channel allocations. Cat B-2325

Was $4.95 **$3**

THE HARD WORD COSTS LESS

AT DSE WE'RE PLUGGED INTO THE HOBBYISTS NEEDS — AND SO WILL YOU BE!

DESCRIPTION	Cat No	WAS	NOW
Plug & Socket 9 pin valve	P-1910	$2.65	**$1.65**
6 pin Din Panel Socket	P-1562	95¢	**65**
2 pin Din Panel Socket	P-1522	55¢	**35¢**
Socket Bread Board	P-4616	$34.95	**$26.95**
Plug & Socket Stereo Metal 2pin	P-1860	$4.95	**$2.95**
Coax Plug Plastic	P-2021	85¢	**50¢**
75 ohm TV Coax Plug	P-2020	$1.95	$1.45
RCA Plastic Plug	P-1420	55¢	**30¢**
BNC Plug	P-2210	$4.25	**$3.25**
3.5mm Stereo Plastic Plug	P-1140	95¢	**65¢**
RCA Plastic Plug	P-1422	55¢	**30¢**
PL259 UHF Line Plug	P-2310	$2.35	**$1.50**
Connector N Female Line (save $5.00)	P-2405	$7.95	**$2.95**
40 Pin DIL IC Socket — ½ price	P-4250	90	**45**
4 way Output Star Plug	P-1670	$2.55	**$1.95**
28 pin DIL IC Socket	P-4245	75¢	**50¢**
Relay Socket PCB Mounting	P-4734	$3.95	**$2.25**
6 pin DIN Line Socket — ½ price	P-1564	$1.05	**50¢**
Adaptor "F" Male to RCA Female — ½ price	P-2100	$3.25	**$1.60**
SO239 UHF Panel Socket	P-2340	$1.95	**$1.50**
15 Pin D Type Plug	P-2687	$3.50	**$2.25**
Coax Joiner Adaptor	P-2070	$1.40	**$1.00**
UHF Joiner	P-2380	$2.85	**$1.85**
36 way Amphenol (save $4.00)	P-2680	$12.95	**$8.95**
40 way DC Connector Card Edge (save $3.00)	P-2762	$11.95	**$8.95**
RCA Line Socket	P-1410	55¢	**40¢**
Adapt 6.5 Stereo/Socket/6.5 Plug	P-6580	$1.65	**$1.25**
Q Range 2 Pin Chassis Socket	P-3115	85¢	**50¢**
Plug 2.5mm Power DC-2	P-1645	70¢	**50¢**
Socket 3.5mm Inline Mono	P-1234	80¢	**50¢**
UHF Tee Connector	P-2384	$4.95	**$3.95**

DICK SMITH ELECTRONICS

You won't believe your luck! All this month we're being terribly foolish; with bargains galore — Hurry!! Get down to your nearest DSE store.

1200MHz Amateur TV Converter

This converter module is identical to those used in block type satellite TV receivers. Ideal for the reception of wide band signals. Can be connected directly to conventional TV set. Cat D-8310

$59.95

'Oskerbloc' VHF Power/SWR Meter

Oskerbloc — the world's most respected name in amateur circles — is available at DSE. It's a "must" for all VHF 2m enthusiasts. Ensures your antenna is working properly every time. Cat Q-1341

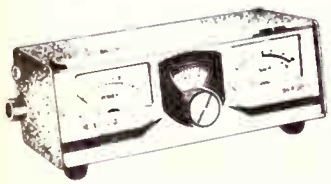
$65 Save $20

Oskerbloc's UHF Power/SWR Meter...

Performs the same super job on UHF antennae PLUS it's ideal for UHF CB. Cat Q-1342

$99 Save $46

.... and for HF users!



This Oskerbloc Power/SWR meter is just the thing... ideal for ALL SW bands. Cat Q-1340

$99 Save $70

GV-16 1.5W VHF Hand-Held Transceiver

Low priced, hand-held. But you don't lose on performance: It covers all 800 channels in the 144-148MHz band, with all the features like repeater splits, thumbwheel tuning, detachable antenna, built-in condensor mic, slider volume control and much, much more! Included NiCad. Cat D-3520

$269 Save $20

2 Metre 5dB Gain Mobile

Fantastic value! 5.2 dB gain corrosion resistant stainless steel mobile antenna for the 2 metre band. Cat D-4320

$79.95

2 metre Yagi

Don't miss this! A 5 element 2 metre Yagi with gamma match at a DSE low price! Cat D-4705

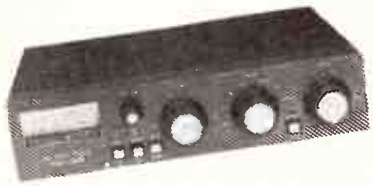
$59.95

'Folded J' 2 metre Vertical

A huge price reduction! Easily installed 'Folded J' 2 metre base station antenna. Hurry, before they all go! Cat D-4211

$19.95

FC-700 Antenna Tuner



Match your transceiver and antenna perfectly! The FC-700 will give you the most from your "rig". Antenna matching can be as easy as turning a dial. Gives maximum power and maximum performance from your valuable gear! Includes large power/SWR meter, built-in dummy load AND covers all WARC HF bands. All this, and there's less than 0.5dB insertion loss! Cat D-2917

Save over $118.00! **$250**

FRA-7700 Active Antenna

Fantastic! With the FRA-7700 Active Antenna you can pick up stations you didn't believe possible. Great for home unit dwellers! Cat D-2845

$119 $30 off!

Quality Yaesu gear at prices to clear!

Yaesu SP55 Mini Extension Speaker

Intended especially for communications use: transceivers, scanners, etc. Just 100 x 65 x 50mm (75mm high in mounting bracket supplied) and rated at 5W. Suits most transceivers (4 ohms imp) complete with 1.5m cable and 3.5mm plug. Cat D-2913

$40 Save over $17

FRG-8800 DC Kit

Allows operation of your FRG-8800 on 12V DC. Great for field operation, monitoring, etc. Great value too! Cat D-2822

$3 Save $5.75!

Mobile Bracket

Oops! Over $20 just fell off the price. Super convenient mobile bracket allows you to instantly connect your FT-290R for mobile use. Cat D-2911

SAVE OVER $20!

$55

SB-10PTT Switch Unit

Suitable for both the FT-2700RH and the FT-270/RH, the SB-10 allows virtual hands-free operation with the headset earphone/microphone. A must for road safety! Cat D-3519

$35 Save over $23

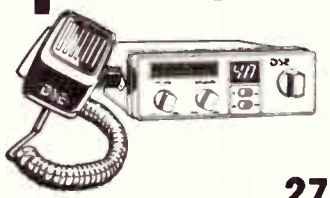
BE QUICK!! THESE PRICES CAN'T LAST!

We've gone overboard on amateur bargains!

CB Price $quelch

Compact CB big on features!

Measures a mere 160 x 44 x 122mm. But it's big on features and performance! Digital frequency display, variable squelch. ANL-Off. Digital signal/RF power meter and TX/MOD indicator. And more!! Cat D-1450



Save $40 $99

Mono Band RF Signalizer All Mode AM/FM/ CW/SSB

Improve your signal! One touch Gain Attenuator spanning an incredibly wide range. Adjustable from Gain +20dB to Att. -25dB by simple knob operation.
Cat D-3828

Save $15!
$54.95

27MHz Super Heavy Duty

Save an amazing $20!! A 27MHz mobile antenna that's ideal for 4WD vehicles or anywhere the going gets rough. Cat D-4078

Save $20 $79

27MHz 100" Base and Lead

High efficiency 27MHz Mobile Antenna with heavy duty spring, base and supply lead! Save over $10!! Cat D-4081

Save $10 $69.95

3.27MHz Magnet Base Antenna

Centre loaded stainless steel construction with heavy magnetic base & 3.3m coax cable with PL- 259 plug. Cat D-4412

$24.95 Save $5

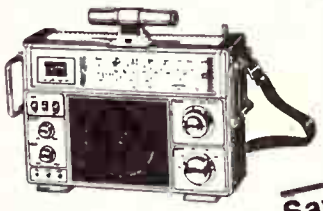
No licence required

Pocket Com II Walkie Talkie

Full two way transmission and it fits into your pocket. A great gift for any child. Also ideal for the more serious use. Buy a few and start a spy ring!
Complies with DOC. Specification RFME001
Cat D-1101

$10.95 Save $5

AM/FM/CB/SW/ VHF with inbuilt Radio D.F.



Top value for the avid radio listener — or the boat owner. This quality radio receiver has a built-in radio direction finder to pinpoint your position against AM radio stations. Plus you get 6 bands including all 40 CB channels plus shortwave AND VHF! And More! Cat D-2832

Save $20! $129

TOOLS

$$$ Saver Sheet Metal Bender

Why buy instrument cases whey you can easily make your own with DSE's Sheet Metal Bender. You'll save $$$ making your own heatsinks, RF shields, trays and covers. Provides a clean, smooth bend up to 90° on metals to 16 gauge. Pays for itself in no time! Cat T-5250

Save $20! Now $59.95

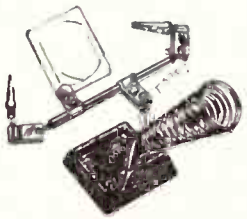
Scope Cordless Solder Gun

For soldering where you want it, when you want it. Powerful enough to handle the same jobs as 60W mains irons, but inbuilt NiCads give you up to 100 solder joints. Includes plugpack. Heats in just six seconds. Supplied with charger, two spare elements and two spare bits.
Cat T-1600

$69

Solder Stand with Magnifier

The helping hand when you need it most: when you have a "hot stick" in your hand! Heavy duty die-cast base, solder stand, clips for holding PD, etc — plus a unique magnifying lens for those close assembly jobs.
Cat T-5710



Was $19.95 Now $15.95

S/S Mini Needle Nose Plier

Precise, non-serrated tip and jaw. Ideal for use with semiconductors — the very fine (1mm) tip will reach into places others won't. Cat T-3570

Was $17.95

Now $8.75

Hot Melt Glue Gun

Want to bond virtually anything to anything? You need a hot melt glue gun! It operates from mains power, heating the glue sticks to operating temperature very quickly. Pistol shape design for ease of use. Complete with mini stand. interchangeable tips. Free pack of twelve glue sticks to suit. Value $5.45
Cat T-4840

Was $16.95

Now $19.95

Spare Glue Sticks: pack of 12 sticks.
Cat T-4841
Wide Nozzle: for large area gluing.
Cat T4842 $4.99

38 Piece Deluxe Repair Kit

Everything for quick and easy wiring repairs. Ideal for automotive and hobby use. Here's what you get:
• Multimeter • Crimp Tool • Pliers
• 2 Screwdrivers • Neo Tester (rated to 500V) • Selection of crimp lugs.
All in a handy, heavy duty carrying case. Cat T-4832

Save $10!

Now $27.95

Baby Driver Set

Handy plastic wallet containing 5 of the most widely used drivers. Ideal for electronics, model makers, repairs, etc. Cat T-4340

Was $8.45 Now $5.95

Budget Price Pocket Size

This budget priced tester is a valued addition to any tool kit. The 3.5 digit LCD provides accurate readings at a glance. RF shielding ensures stable readings. Overload protected, all ohms ranges handle 250V AC or 350V DC indefinitely! Cat Q-1520

$49.95

Free protective cover value $10.95. Cat Q-1522

AF Signal Generator

Square/Sine wave output audio signal generator, essential for work on huge range of circuits. With wide 20Hz-200kHZ output and high accuracy, it is the perfect partner for the RF generator. Cat Q-1310

$140
Save $30!

Dual Trace 20MHz CRO

A professional standard 20MHZ oscilloscope! Bandwidth: DC to 20MHz (-3dB). Impedance: 1m ohm to 25pF
+-2%. Algebraic addition: CHI+CHII, -CHI+CHII. Sweep time: 0.1us/DIV - 0.2s/DIV +/-3% (10°C - 35°C) steps in 1-2-5 sequence. And More!
Cat Q-1260.

$849
Save $100!

Push Button LCD Multimeter

Where else but DSE could you find a quality LCD multimeter at this incredibly low price. Features push button range selection, large 13mm LCD display, bench stand, diode check facility and overload protection. Cat Q-1444

Save $30. $49

Huge Hobbyist's $avings We told you you'd be laughing!

UP TO 50% OFF AND MORE!!

More Bargains!

Cable BNC to BNC for video W-1285
Was $7.95 **Now $5.95**
Universal Test Lead W-4528
Was $19.95 **Now $16.95**
PC board 12 x 12 bakelite H-5510
Was $10.95 **Now $7.95**
Draw component tray (save over ½ price) H-2585
Was $4.15 **Now $2.00**
Tag 6 pole H-6626
Was 0.80 **Now 0.50**
Verner 6:1 ratio drives (½ price) H-3901
Was $8.25 **Now $4.10**
Tag 2 pole (½ price) H-6622
Was 0.85 **Now 0.40**
Plastic instrument case (½ price) H-2525
Was $37.95 **Now $18.95**
Metal cabinet 102 X 56 X 83mm (½ price) H-2741
Was $4.70 **Now $2.35**
Tag 12 pole strip H-6712
Was $6.95 **Now $4.95**
Tag 4 pole strip H-6704
Was $3.45 **Now $2.00**
Tag 4 pole H-6624
Was $1.25 **Now 0.75**
Heatsink 75m 2 x T0-3 H-3461
Was $6.55 **Now $3.25**
Instrument case 200 x 135 x 95 (½ price) H-2506
Was $14.25 **Now $7.12**
33uF 10V electrolytic cap R-4330
Was 0.10 **Now 0.01**
Trimpot multiturn PC 100K R-1910
Was $1.25 **Now 0.75**
Resistor pack 1% 300pc ¼ watt R-7020
Was $19.75 **Now $10.00**
47uF 25V electrolytic cap R-4350
Was 0.35 **Now 0.10**
.047uF 100V green cap R-2080
Was 0.30 **Now 0.10**
40V RG 10000MFD electro (save nearly ½ price) R-4595
Was $9.75 **Now $5.00**
Resistor pack 1% 300pc ¼ watt R-7015
Was $17.55 **Now $10.00**
Pot-w/wound 6mm 3m 200 ohm R-6911
Was $4.10 **Now $1.00**
¼" pot carbon SG lin 500K ohm R-1812
Was $1.20 **Now 0.50**
¼" pot carbon SG lin 100K ohm R-1824
Was $1.30 **Now 0.50**
2.2uF 25V electrolytic cap R-4300
Was 0.30 **Now 0.10**

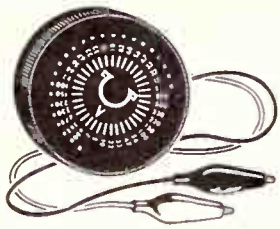
Half Price Cable

Mini twin heavy duty cable (½ price of $15 per roll) W-2012
Was 0.40 **Now 0.20**
SC2/A twin shield figure 8 (½ price or $30 per roll) W-2036
Was 0.85 **Now 0.40**
Hook up wire 23/0.20 black (½ price or $10/roll) W-2262
Was 0.30 **Now 0.15**
Hook up wire 10 X 0.12 red ($5 per roll) W-2220
Was 0.15 **Now 0.07**
Hook up wire 23/0.20 (½ price or $10 per roll) W-2260
Was 0.30 **Now 0.15**
Hook up wire black 10/0.254 ($9 per roll) W-2242
Was 0.25 **Now 0.12**
Hook up wire green 10/0.12 ($5 per roll) W-2225
Was 0.15 **Now 0.07**

Resistance Substitution Wheel

Convenient size with large, easy to read value selection that enables you to select values from 5 ohms to 1M ohm in 36 steps. Complete with leads and insulated crocodile clips.
Cat Q-1410

$12.95
Was $16.95



Moving Coil Panel Meter

A high quality moving coil meter with full scale accuracy better than 2%. Pre-calibrated; easily adapted to suit virtually any requirement! Cat Q-2020

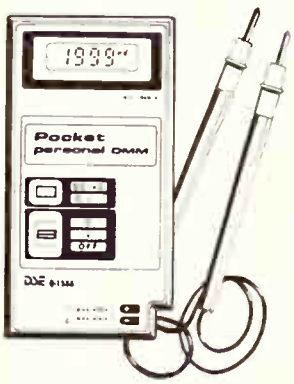
Great Value!
Only $8.95

Save over $6!

LCD Multimeter Cap/Transistor Checker

The very latest — and the very best — digital multimeter. And multi is the word. Also checks capacitors PLUS transistors and diodes. It's got an audible continuity checker! Cat Q-1500

$99
Save $40!

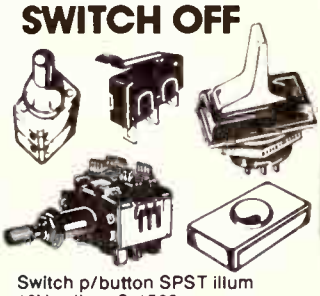


Personal LCD with Auto Ranging

An amazing feature-packed 3.5 digit multimeter that's the size of a pocket calculator: only 10mm thick! It may be small but boasts a number of impressive features.
Cat Q-1555

$49.95
Save $10!

SWITCH ON TO DSE BEFORE THE BARGAINS SWITCH OFF



Switch p/button SPST illum 12V yellow S-1523
Now $10.95
Relay MHS4P 4PDT 185 ohm 12V S-7020
Was $14.95 **Now $9.95**
Switch ill p/button red S-1078
Was $3.25 **Now $2.25**
Switch ultra mini PCB 90° toggle S-1245
Was $3.95 **Now $1.95**
Switch waterproof Toggle S-1195
Was $7.65 **Now $5.95**
Switch mini p/button DPDT S-1220
Was $4.95 **Now $3.45**
Relay light DP (½ price) S-7304
Was $24.95 **Now $12.47**
12 V mini relay S-7112
Was $4.95 **Now $3.95**
Switch slide SPDT (save $1) S-2060
Was $1.30 **Now 0.30**
Switch slide SP6T S-2050
Was 0.95 **Now 0.50**
Switch PCB mount SPDT (only 1c each) S-1950
Was 0.10 **Now 0.01**
Switch level action 4PDT (save $1.50) S-1301
Was $2.75 **Now $1.25**
Switch u/mini PCB 90° toggle DPDT S-1249
Was $3.25 **Now $1.25**
Switch bank of 4 DPDT interlock S-1904
Was $5.45 **Now $3.45**
S/W mini toggle DPDT on/off S-1287
Was $4.95 **Now $2.95**
Switch mini toggle r/angle DPDT S-1177
Now $1.40
Globe lilliput 6.3V S-3836
Was 0.55 **Now 0.25**
Switch single bank DPDT S-1906
Was $2.45 **Now $1.00**
Switch u/mini PC C/O toggle DPDT (save $2) S-1251
Was $3.60 **Now $1.60**
Holder fuse chassis PC mount (½ price) S-4258
Was 0.65 **Now 0.32**
Thermal fuse 250V 10A 96° S-4490
Was $1.35 **Now 0.60**
Globe socket S-3880
Was $1.05 **Now 0.60**
Switch u/mini p/button SPDT (½ price) S-1253
Was $3.05 **Now $1.50**
Bezel; u/MminiLED 2V green S-3529
Was $1.85 **Now $1.00**
Switch pull on/push off DC24V 1CA S-1190
Was $4.50 **Now $3.00**
Switch u/mini PCB 90° toggle SPDT S-1247
Was $2.75 **Now $1.75**
Plug & socket 9 pin valve S-1910
Was $2.65 **Now $1.65**
6 pin DIN panel socket S-1562
Was 0.95 **Now 0.65**
2 pin DON panel socket S-1522
Was 0.55 **Now 0.35**

DICK SMITH ELECTRONICS
PTY LTD

Metric Screw Packs

Description	Quantity	Cat No	Price
Asst P/H S/Tap Screws	160pc	H-1500	$1.00
	150pc	H-1505	$1.00

Grommets

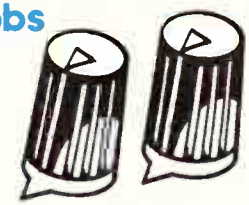
Heavy duty grommets made of Black Rubber. Essential when cable passes through a metal chassis as they will prevent frayed cables and live chassis.
Cat H-1719

Hole Size	Bore	No. In pack	Price	10 up
12mm	9	8	$1.25	$1.15

Insulated Spacers

The ideal spacer for insulating the chassis from your PC board. They come complete with screws.
25mm 4 H-1872 $3.25 $2.48

Coloured Plastic Knobs

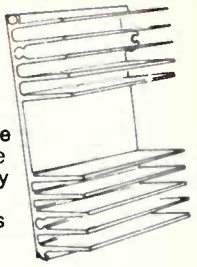


What a colourful idea! Now your projects can really look the part with these snazzy coloured knobs. Use them to colour code sections (great on multi-channel mixers, lighting consoles, etc). 16mm diam, standard metric (fluted shaft) fitting. Inserts can be changed to suit the occasion! Choice of four with-it colours.
All one price:

87¢ each

Orange Cat H-3802, Red Cat H-3800, Green Cat H-3806, Blue Cat H-3804.

Versatile Power Heatsink



The ingenious design of this heatsink makes it possible to mount it either flat on a panel, or at right angles to it (eg inside a case). The side fins also have tongue and groove so they may be joined sideways. Drilled version takes 2x TO-3's. Size is 78 x 110 x 33mm. Cat H-3460
Undrilled 1-4 $6.36 ea
5 or more $5.72 ea

Assorted Metric Screw Pack

Over 200 pieces of the most popular small sizes: M2.5, 3 and 4 nuts and screws — cross, round and countersunk head. Plated finish, ideal to have on hand in the workshop! Cat H-1680

$4.97

STORE LOCATIONS

NSW			ACT			SA		
Swift & Young Sts.	Albury	(060)21 8399	96 Gladstone St	Fyshwick	(062)80 4944	Cnr Pacific Hwy & Kingston Rd	Underwood	(07)341 0844
T55 Terrace Level	Bankstown Sq	(02)707 4888	VIC			SA		
Shop 1, 65-75 Main St	Blacktown	(02)671 7722	Creswick Rd & Webster St	Ballarat	(053)31 5433	77 Grenfell St	Adelaide	(08)232 1200
613 Princess Hwy	Blakehurst	(02)546 7744	145 McCrae St	Bendigo	(054)43 0388	Main South & Flagstaff Rds	Darlington	(08)298 8977
Oxford & Adelaide Sts	Bondi Junction	(02)387 1444	Shop 46,Box Hill Central,Main St	Box Hill	(03)890 0699	Main North Rd & Darlington St	Enfield	(08)260 6088
Shop 2, 1B Cross St, Warringah Mall	Brookvale	(02)93 0441	Hawthorn Rd & Nepean Hwy 260 Sydney Rd	East Brighton Coburg	(03)592 2366 (03)383 4455	24 Park Terrace WA	Salisbury	(08)281 1593
Campbelltown Mall Queen St	Campbelltown	(046)27 2199	1150 Mt Alexander Rd	Essendon	(03)379 7444	Wharf St & Albany Hwy	Cannington	(09)451 8666
Shop 235, Archer St Entrance	Chatswood Chase	(02)411 1955	Nepean Hwy & Ross Smith Ave	Frankston	(03)783 9144	66 Adelaide St	Fremantle	(09)335 9733
147 Hume Hwy	Chullora	(02)642 8922	Shop 9 110, High St	Geelong	(052)43 8522	William St & Robinson Ave	North Perth	(09)328 6944
164 Pacific Hwy	Gore Hill	(02)439 5311	291-293 Elizabeth St	Melbourne City	(03)67 9834	Raine Square, 125 William St	Perth City	(09)481 3281
315 Mann St	Gosford	(043)25 0235	Bridge Rd & The Boulevarde	Richmond	(03)428 1614	TAS		
4 Florence St	Hornsby	(02)477 6633	Shop 2, 141 Maroondah Hwy	Ringwood	(03)879 5338	Shop 40A, Lower Level		
Elizabeth Dr & Bathurst St	Liverpool	(02)600 9888	Springvale & Dandenong Rds	Springvale	(03)547 0522	Cat & Fiddle Arcade	Hobart	(002)31 0800
450 High Street	Maitland	(049)33 7866	QLD			NT		
621-627 The Kingsway	Miranda	(02)525 2722	157-159 Elizabeth St	Brisbane City	(07)229 9377	17 Stuart Hwy	Stuart Park	(089)81 1977
173 Maitland Rd, Tighes Hill	Newcastle	(049)61 1896	166 Logan Rd	Buranda	(07)391 6233			
Lane Cove & Waterloo Rds	North Ryde	(02)88 3855	Gympie & Hamilton Rds	Chermside	(07)359 6255			
George & Smith Sts	Parramatta	(02)689 2188	Queen Elizabeth Dr & Bernard St	Rockhampton	(079)27 9644			
The Gateway High & Henry Sts	Penrith	(047)32 3400	2nd Level Western Entrance					
818 George St	Railway Square	(02)211 3777	Redbank Shopping Plaza	Redbank	(07)288 5599			
125 York St	Sydney City	(02)267 9111	Gold Coast Hwy & Welch St	Southport	(075)32 9863			
Treloar's Bldg, Brisbane St	Tamworth	(067)66 1711	Bowen & Ruthven Sts	Toowoomba	(076)38 4300			
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Dear Customers,

Quite often, the products we advertise are so popular they run out within a few days, or unforseen circumstances might hold up shipments so that advertised lines are not in the stores by the time the advert appears. And very occasionally, an error might slip through our checks and appear in the advert (after all, we're human too!) Please don't blame the store manager or staff: they cannot solve a dock strike on the other side of the world, nor fix an error that's appeared in print. If you're about to drive across town to pick up an advertised line, why not play it safe and give them a call first... just in case! Thanks. Dick Smith Electronics.

MAJOR DICK SMITH ELECTRONICS AUTHORISED RESELLERS

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ANNOUNCING...

Symeon Young Marketing offers scientific and electronic products and devices. The company holds many sole and exclusive distributorships on items ranging from consumer products such as electronic insect killers to military and weapons development in the fields of infrared, ultrasonic, magnetic and high energy research. Symeon Young Marketing is constantly engaged in research and development pertaining to new devices and concepts that often develop into useful and popular products. Some are made accessible as do-it-yourself projects, many of which in completed form would not be available. Often our ideas and innovations are not feasible for direct marketing due to laws, approvals, etc., and therefore find their way into our catalogue as only plans or plans/kits. Our catalogue offers products, kits and plans and completed units on many impossible to find, useful and interesting items. Plans data is intended for the home builder or hobbist with a minimum of experience.

SHOTGUN DIRECTIONAL MICROPHONE — Kit contains cut tubes and all fab parts for use in building a super directional highly sensitive microphone. All electrical components are supplied that are necessary in constructing this device. The unit also includes our high gain amplifier described as our HGA1K. When combined, good results can be obtained such as sounds being heard through windows, picking out whispers in crowds from considerable distances, etc. SM3K . . . kit/plans.

STARLIGHT NIGHT VISION — Our very best top quality. These are the devices used by the professionals. Requires no bulky IR source. Unlimited viewing range. Amplifies light 12,000x. Completely self-contained. Optimal performance is achieved through the use of an advanced hybrid power supply. Brightness and gain are controlled automatically for increased resistance to spurious illumination, reduced blooming and greater overall longevity of the image intensifier. This advanced electro-optical system is coupled with a quality telephoto objective and six element eyepiece with cross hair reticle. Enclosed in a cast aluminum, wrinkle finished housing incorporating integral rechargeable batteries. The result is an extremely rugged system well suited for general surveillance work in an urban or rural environment.
16-2. Comes with optional protective carrying case and biocular eyepiece . . . (allows viewing with both eyes).

SIGNAL ACTIVATED SWITCH — This neat little gadget is intended to operate any electrical device such as tape recorders, alarms, etc., when voices or sounds are received on a standard FM radio. Threshold of activation is preset by the radio volume control. Use with our wireless devices for automatic recording of transmissions. SAS2K . . . **$147.50** kit SAS20 . . . assembled and tested.

HIGH VOLTAGE GENERATOR — Produces a variable output from 25 to 200kV DC intended for a multitude of laboratory and research functions. Oil filled enclosure provides reliable operation for extended periods of time. Construction is in two parts consisting of control console box and power oscillator multiplier section. Polarity reversible by simple changing of multiplier section. Operates from mains power VAC grounded outlet . . . optional designs available on special request. HVG1K . . . **$1,247.50** plans/kit HVG10 . . . assembled and tested (150kV)

TALK AND TELL — Amazing electronic device automatically records all phone conversations whenever telephone is being used. Clearly records both parties providing a means of obtaining accurate messages or preventing unauthorized use of a phone. Does not interfere with normal phone operation in any way. Automatically turns recorder on and off. Requires no maintainance or batteries. Subminiature and easily concealable also extends tape time. Complete with plugs and jacks. TAT2K . . . kit/plans TAT20 . . . assembled and tested.

HNE30 — AC Powered universal mains power supply. Works with all hene tubes from .3 to 10mw . . . ready to use.

MINI-LONG RANGE VOICE TRANSMITTER — Listening device allows the user to monitor and secure check points around house/office or other premises where "listening in" may be advantageous. Unit occupies a volume of slightly more than a cubic inch yet can transmit low level sounds or voices many kilometres producing crystal clear audio quality through a standard FM radio receiver. Tuning controls allow adjustment to a clear frequency or channel. Unit operates on standard batteries for many months or can be permanently powered by a miniature power supply running off normal house current. Also operates from any vehicle 12 volt battery. MFT1K . . . **$247.50** kit with PC board/plans.

LONG RANGE PARABOLIC MICROPHONE — With wireless FM transmitter not only allows the efficient picking up of distant and low level weak sounds but also wirelessly transmits them to a remotely located FM radio receiver. This set up is excellent for the serious nature listener who requires gathering sounds from distant target areas and then rebroadcasting to a conveniently locaited FM radio for recording and evaluation purposes. Use for nature studies in swamps, etc. May also be used with headsets. PWM5K . . . kit with wireless PWM50 . . . above with assembled and tested electronics and all fabricated parts PM5K . . . kit of above but without the FM wireless transmitter. For use with headsets PM50 . . . above with assembled and tested electronics and all fabricated parts.

FM BROADCAST TRANSMITTER — Unique circuit allows you to broadcast over standard radio. Be a neighbourhood disc jockey, communicate with your friends, or use for monitoring an area. Circuit is range adjustable. Unit is similar to above but is packaged in an aluminum mini box. Can be great intrusion alarm or wireless baby sitter. FC1SK . . . **$297.50** kit/plans.

GRAVITY GENERATOR — This unique machine demonstrates a simple electrical phenomena that produces an anti-gravity effect. You can actually build a small mock spaceship and without any visible means, cause it to levitate. This is a great science fair demonstration as well as a very interesting device. Phenomena and method of use may be elaborated on and we welcome any suggestions and findings that the experimenter may come upon. (excellent co-op research and development study). GRA1K . . . **$497.50** kit power supply/plans GRA10 . . . assembled and tested power supply.

HIGH PERFORMANCE PORTABLE BATTERY OR AC AM/FM RADIO — High band receiver interfaces with all our equipment described and provides excellent performance. External jacks for recorders, auxiliary inputs and other functions. Complete with telescopic antenna. FMR20 . . . complete unit.

FIELD STRENGTH METER — This device is a great aid when using any wireless transmitter that transmits in and around the FM broadcast band. Relative field strength is indicated via a sensitivity adjustable meter. Turning knob calibrated to provide a frequency indication. Unit is a must for serious optimizing of any wireless transmitting system. FSM1K . . . **$147.50** kit/plans FSM10 is ready to use.

VOICE OPERATED WIRELESS PHONE DEVICE — This neat little device broadcasts both sides of a telephone conversation to any nearby FM radio with crystal clear clarity over considerable distances. The unique feature of this device is that it only transmits a signal when the telephone is being used thus conserving the batteries and eliminating unnecessary soundless transmissions. Also allows several units to be used simultaneously on different lines with one monitoring receiver. It is intended for remote listening of home or office phone while performing other duties. Easily installed anywhere on phone lines. Does not interfere with normal telephone operations. VWPM5K . . . **$197.50** kit/plans.

SOUND OPERATED PARABOLIC MIKE — Contains a sound activating switch along with the amplifier in the above PM3. It is intended for automatically recording sounds as they occur eliminating wasted and dead tape time. Can also be used to trigger any electrical device by sound. Unit is fully adjustable for both recording levels and recorder activation. USAR1K . . . **$597.50** kit/plans USAR10 . . . above with assembled and tested electronics and all fabricated parts.

CVL1 — COPPER VAPOR LASER — Produces 100mw beam of visible green light. High coherency and spectral quality similar to argon laser but easier and less costly to build yet far more efficient. This particular design was developed at the Atomic Energy Commission of Negev in Israel.

PHASER PAIN FIELD — This device has recently been developed and patented and is presently being evaluated by U.S. State and Government agencies for riot and crowd control. It is now available but soon will come under the jurisdiction of weapons and infernal machine control, making it unavailable to the public. The device consists of an array of 4 transducers that are powered by a programmable source of ultrasonic energy between 10 and 22kHz. Unit automatically sweeps between preset limits at a preset programmable rate. Produces a directional field of ultrasonic energy at 125DB plus. Unit is 17 x 17 x 28cm and can easily be hand held similar to a megaphone. It can be powered by a 12 volt source such as a car cigarette lighter or internal NI-CAD batteries. Similar, but more powerful unit is our PCC1 that contains 8 transducers in an array. PPF1K . . . kit/plans PPF10 . . . assembled and tested (with 4 transducers) PCC1K . . . kit/plans PCC10 . . . assembled and tested (with 8 transducers)

REMOTE WIRELESS WIZARD REPEATER TRANSMITTER — Allows any tape recorder hi-fi or other similar device to transmit its output to a nearby FM radio tuned to the desired frequency. Now you can have your favourite tapes, records etc., played on your good quality home hi-fi and rebroadcast to a portable or another conveniently located FM radio. The unit is self contained and does not require any internal wiring to those devices, just plug into speaker or earphone output. The unit including battery is no larger than your thumb, but will broadcast over considerable distances. Also intended to rebroadcast remotely located parabolic, shotgun or other sensitive listening devices. Complete with necessary plugs, jacks. RWM3K . . . **$147.50** kit/plans.

A New Era in Project Building.

POLICE CALL UNSCRAMBLER — Allows you to decipher many of those interesting communications on the airwaves by simply connecting this neat little unit to the earphone jack on radio. US7K . . . **$247.50** kit/plans US70 . . . assembled and tested.

MAGNETIC FIELD DISTORTION DETECTOR — This all new ultra sensitive device allows one to listen to, measure and record any magnetic disturbances. Easily detects aircraft, automobiles, UFO's? etc. by sensing the slightest change in the Earth's magnetic field as they pass through these lines of force. This is a great research/development and science fair device having many practical applications in working with magnetism, detecting magnetic storms from sun spots and the forewarning of intense disturbances that can cause power line damage and many other costly failures. Will detect flux change in the microgauss. MGD1K . . . **$747.50** kit/plans MGD10 . . . assembled and tested by special request.

PORTABLE HIGH ENERGY SOURCE/PLASMA PROPULSION DEVICE — Produces megawatt pulses of electrical energy capable of exploding wires, creating shock and blast waves, spot welding etc. Classified R & D using water to generate hyper-velocities, emp generation, plasma and pulsed magnetics. HEG1K . . . kit/plans. Caution: These are hazardous electrical devices intended for lab use only.

HIGH GAIN ANTENNA — Intended to be used with our FM receivers for picking up and greatly extending the range of any wireless devices. Can also be used with transmitting devices. HA20 . . . dipole antenna/transmission line and all insulators.

IRP1 — INFRARED INDICATOR — This useful device produces visible light from infrared and is a must for anyone experimenting with IR. It is truly a super handy device to have and is virtually indestructible, it never wears out. Assembled and tested $50.00.

AGG — ATOM SMASHER — Full construction plans (only) on building a medium energy particle accelerator that will split atoms! This is a lab quality device! Plans include full details on a high voltage multiplier, accelerator assembly and complete high vacuum system. Plans only **$75.00.**

PORTABLE X-RAY MACHINE — Easy to construct plans to build X-ray machine! Device effectively X-rays sealed assemblies, can also be used to experiment with such fields as fracture and flaw testing and welding tester . . . not a toy or intended for minors — radiation hazard. XP1 . . . plans only **$50.00** plans by special request.

VAN DE GRAFF HIGH VOLTAGE GENERATOR — 3 million volts crashing lightning bolts! This is not a toy, but a professional quality research instrument. HV1 . . . **$50.00** plans only.

SOUND CONTROLLED SWITCH — Turning anything off or on with the sound of your voice or a clap of your hands! It is sensitive enough to work with a whisper at 3 metres . . . sold as single units.

SOLID STATE INJECTION LASER SYSTEMS — Useful laboratory and field lasers emit variable rate and power pulses of infrared energy at 9000A. This type of laser is easy to operate. Its usefulness lies in its ruggedness and adaption to miniaturization. It is useful in fibre optics communications, target designation, simulated weapons fire, long range optical link, high resolution radar, ranging, intrusion detection, etc. The device is built in 2 parts. The laser head and optics housed in a cylindrical housing and the pulser power supply and controls housed in a metal or PVC enclosure. The 2 are connected via an umbilical cord. Choice of many types of laser diodes with pulse currents of 20-60 amps . . . see our laser diode selection.

SNOOPER PHONE — This is the latest in home or office security devices that enables the user to dial their own telephone from anywhere in the world and "listen in" via a highly sensitive microphone that can be placed anywhere on the premises. Phone automatically turns on mike without ever ringing when last digit of number is dialed and remains activated for a predetermined time. Use to check premises against unauthorized intrusion, proper functioning of utilities and other machinery and security devices while away on vacation, etc. Easy to operate, installs with standard phone plug and extension jacks. Adjustable sensitivity can be preset to pick up any desired level of sounds. May also be used to turn on other electrical devices when used in conjunction with our SCU1. SNP2K . . . kit/plans SNP20 . . . assembled and tested unit.

INVISIBLE SENTRY/PROPERTY GUARD ALARM SYSTEM — One of our latest products is a completely automatic foolproof guard alarm system for your property, home, warehouse, office, factory etc. Nothing and no-one can penetrate the invisible silent shield without being detected. System automatically tells you where and what on a remote panel, can activate floodlights, sirens, bells, etc. Easy, quick and inexpensive to install. ISP1K . . . **$647.50** kit ISP10 . . . kit with assembled and tested electronic modules, final construction involves only mechanical assembly.

HIGH POWERED RUBY LASER — Produces a highly intense pulse of visible red light capable of blasting a hole through the hardest of metals. This is the device that started "it all" and still finds a valuable niche in many of todays laser applications. Theory of operation lends itself to becoming one approach to a modern day Buck Roger's ray gun. This system is built in the parts consisting of the power supply/energy storage section and the laser head/ignition section. These are connected via an umbilical cord and allows easy control and aiming of the laser head action. This particular device produces a pulse of light capable of being seen if one was on the moon looking towards the Earth. A colour temperature equivalent of many million degree Kelvin is obtainable with this device.

BATTERY CHARGERS/ELIMINATORS — Plans to construct three different units. Kits can be assembled at extra cost. BC12K . . . kit/plans delivers 12 volts 3 amps BCM1K . . . kit/plans delivers 12 volts at .2 amps for multi cells BC9K . . . kit/plans battery eliminator/charger works well with our wireless devices for permanent installations.

PULSED TV JOKER — Little hand held device utilizes pulse techniques that will completely disrupt TV picture and sound! Great as a gag or party joke. Works on FM radio too. DISCRETION ADVISED TJSK . . . **$172.50** kit/plans.

BURNING CUTTING CO2 LASER — Projects an invisible beam of heat capable of burning and melting materials over a considerable distance. This laser is one of the most efficient devices converting the maximum potential of its input power into useful output. Not only is the device a workhorse in welding, cutting and heat processing materials but it also is a likely candidate as an effective directed energy beam weapon against missiles, aircraft, ground to ground, etc. Particle beams may very well utilize a laser of this type to blast a channel in the atmosphere for a high energy stream of neutrons or other particles. The unit is built in two parts consisting of the water cooled laser head with a plasma discharge tube and necessary optics. The power supply is connected via an umbilical cord and allows remote control of the system. Device is easily applicable to burning and etching wood, cutting plastics, textiles, trimming and metal work. LC5CH . . . laser head assembled LC5CP . . . laser power supply (Custom built systems upon request).

CPFG1 — PARTICLE BEAN GENERATOR/PROTON ACCELERTOR — Complicated plans show how to construct a particle accelerator using tandem and paralleled cockcroft walton voltage multipliers. Also shown is our approach to the design of a particle beam weapon. Plans involve vacuum systems, high voltage power supplies and are considered moderately complicated and hazardous. Plans only **$100.00.**

VOICE SCRAMBLER — Minature solid state module turns speech sounds into undecipherable noise that cannot be understood without a second matched unit. Use on telephone to prevent third party listening by nosey neighbours and bugging. Use for those private calls. VS9K . . . **$497.50** kit (1set = 2units) VS90 . . . assembled and tested (1set = 2units).

LN1 — NITROGEN LASER — Now, at last, a simple, economical gas laser operating in the UV range at 337nm. Pulse power to 100kW at adjustable repetition rate up to 120 pulses per second. The ionization produced is being studied for use in directed energy beam weapons. This device is truly a fantastic system to construct for the results obtained. All parts are available from Syneon Young Marketing. Great for exciting the dye laser.

ULTRASONIC GENERATOR — This device is capable of generating accoustical ultrasonic energy. Unit has a frequency control and varies from 19-25kHz. Device will atomize water and affect certain animals, can be used for proximity detection, remote control, echo ranging, destructive testing and directional intrusion devices. Many interesting experiments can be programmed using this device. ULG3K . . . **$172.50** kit/plans UL630 . . . assembled and tested unit.

LRP10 — Universal battery power supply. For all .3 to 2mw hene laser tubes. Make your own laser and eliminate complicated elect. assembly. Great for those who want to make a weapons sight. Ready to use.

For full construction and price details and free catalogue, write to or phone:- S.Y.M. Electronics, PO Box 296, Clifton Hill, Melbourne, 3068. Ph: (03) 500 0078. All projects are available as kits, fully-assembled or circuit diagrams only. many of these projects will be fully described in E.T.I.

As seen on Viatel node 277 *VHS tapes are available on all projects.*

ADVERTISING INFO No. 40

MUTT MINDER

Man's best friend can develop some very anti-social habits, especially towards those who deliver mail, go jogging or ride a push-bike through a dog infested neighbourhood. This little project will make the mutt keep his distance.

DOGS AND SOME other animals have ears with a quite different frequency response from people. They can hear sounds quite well at high frequencies which are inaudible to us. One can use this simple fact of life to build a device that will sound extremely loud to a dog but be inaudible to humans. That is what this project is about.

It emits ultrasonic audio waves from a transducer on the front panel at a frequency around 20 kHz. Most people will not hear anything at this frequency, although children and young women, who have extremely good high frequency hearing might be able to detect a high pitched whistle. However, dogs will hear it as a deafening howl, which nine times out of 10 they will avoid like the plague.

To use the Mutt Minder, just wave the box in front of the dog and press the button briefly. If this is done a couple of times it will quickly associate you with an unpleasant noise and stay away. Some authorities issue a caution though; don't depend on the device too much. Some dogs that are trained to attack may well get more aggressive rather than go away. You should only use it when you have reason to fear for your safety.

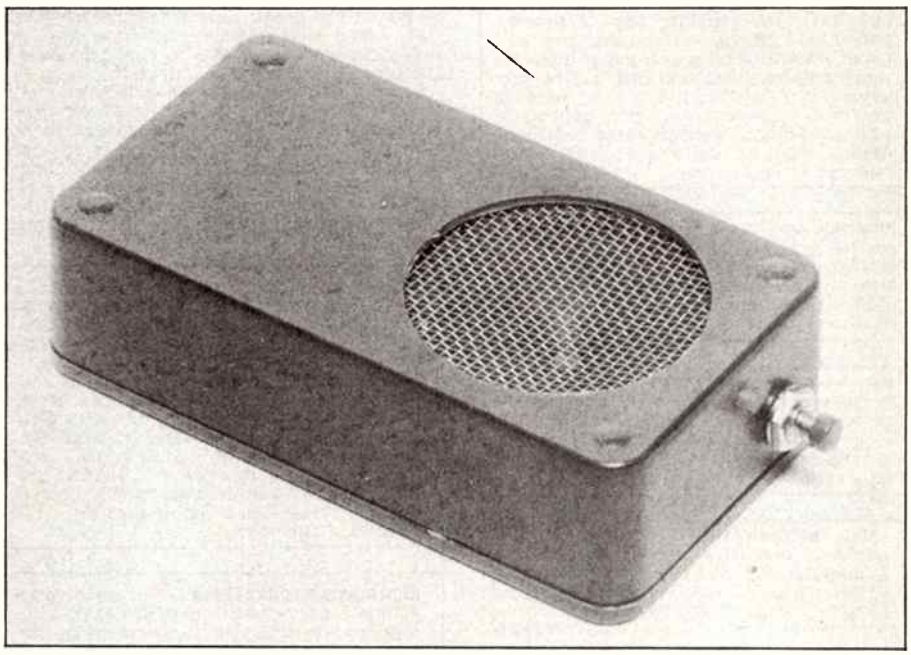
It's also worthwhile noting that you should only use the minder in short bursts. Firstly, the transducer is very current hungry, so it will drain the batteries quite quickly if used for an extended period. Secondly, extended exposure to humans can cause nausea in sensitive people.

Construction

The kit is supplied complete with box, transducer and a wire mesh which is the thing that actually emits the ultrasonics. The first step is to check that you have all the parts, paying particular attention to the circuit board. Make sure it is free of bridged and broken tracks and clean it properly. If holes have not been drilled it will be necessary to do this now. Apart from the big hole on the front of the box for the transducer, it will also be necessary to drill a hole for the switch and the trimpot. To drill the switch hole, place the piezo in position, and determine the best position for the switch before drilling the hole. The trimpot hole can be marked by putting the trimpot in the board, and the board in the box resting on a piece of insulating styrofoam. Then drill the hole such that you can insert a screwdriver through it to turn the trimpot.

The next step is to mount the flying leads. First, put the bare board in its proper position in the box, together with the switch, piezo and battery. Measure sufficient length of lead to make all the required connections and solder them onto the board. Then mount all the components, taking care to preserve the proper polarity. Pay special attention to the transformer. It has two sets of leads, one connected to the 1000 ohm windings and one set to the 8 ohm windings. You can determine which is which with a multimeter, although don't expect the windings to read the correct resistance since there is quite a range of tolerance. Remove the high resistance leads and solder the low resistance leads onto the board.

It is best to mount the small bits first, then the transformer. Mount the IC and



ETI-286 — HOW IT WORKS

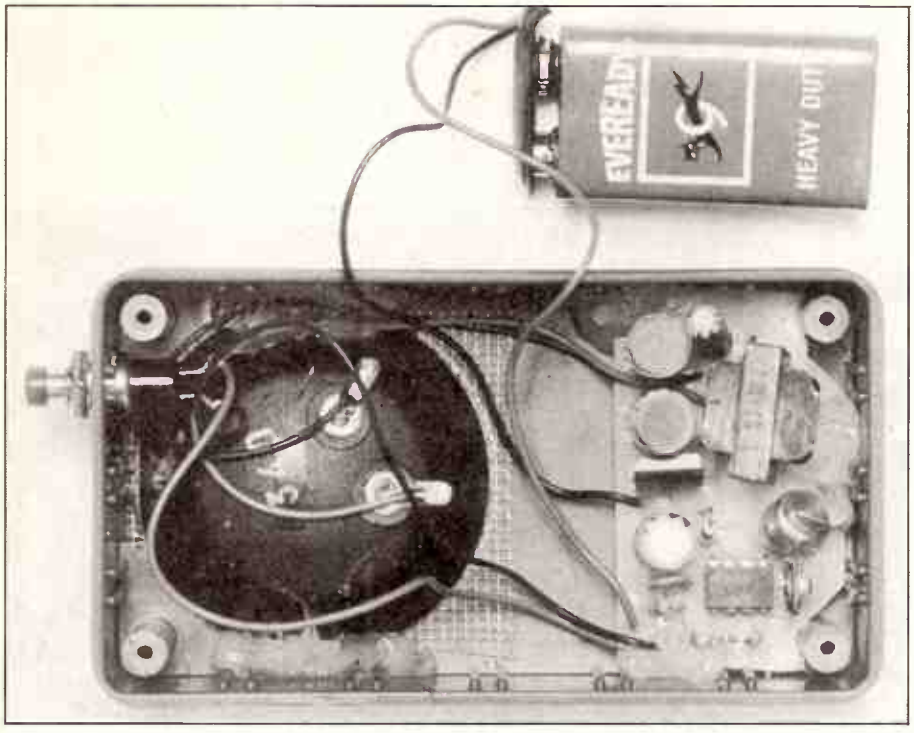
A 555 timer, IC1, is connected as an astable oscillator set somewhere between 16-21 kHz, and along with R1, R2 and C2 determines the frequency and symmetry of the outut waveform. Adjustment of this frequency is by trimmer RV1. Output is taken from pin 3 and is resistively coupled to the base of Q1. This is operated in a class C mode.

Positive pulses occurring at the collector of Q1 drive TR1 through inductor L1 which forms a resonant circuit with the internal capacity of TR1. It should be noted that TR1 has an inherent capacitance of about 150μF and this must be tuned out via the series inductance of L1 for efficient power transfer. Note that L1 may be tunable for maximizing results at a set frequency.

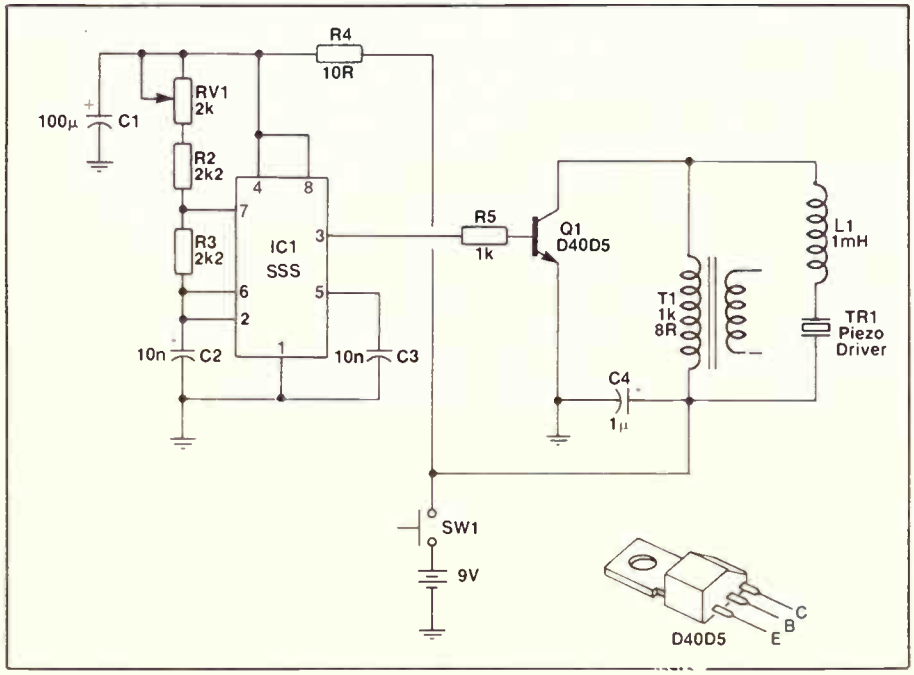
T1 is the 8 ohm section of a transformer and serves as an audio choke while offering only its dc resistance for feeding the collector of Q1. The battery is a standard 9 volt transistor radio or can be a rechargeable nicad.

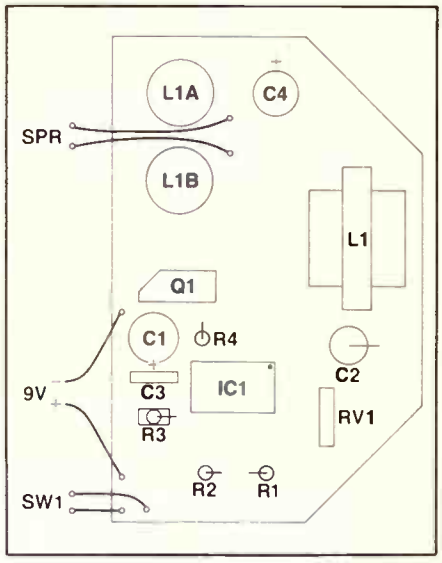
Q1 last of all.

Because the circuit board is so small it is easy enough to mount by putting a bit of styrofoam underneath, then dropping some blobs of silicon on top. The wire mesh can now also be placed over the big hole and the transducer mounted in place. Once again use some silicon to hold it in. Finally, screw the switch through the hole in the side. Now solder the flying leads onto the tags of the transducer and the switch.



Inside the Mutt Minder.





Testing

Use a multimeter to check for the absence of shorts or other gross defects when the switch is closed. Then rotate RV1 fully counter clockwise (low frequency end) and connect the battery, connecting the meter in series with the supply. Note a current drain of about 250 mA when you turn the unit on, together with (maybe) an unpleasant whistle coming from the unit. Turn RV1 clockwise and note that the drain goes up to 350 mA. You should set RV1 so that you can't hear the transducer when it's on. ●

ETI 286 — PARTS LIST

Resistors

R1,2	2k2
R3	10R
R4	1k
RV1	2k trim

Capacitors

C1	100µ 25 V electro
C2	10n 50 V poly
C3	10n ceramic
C4	1µ 50 V electro

Inductors

T1	1k:8R transformer
L1	1 mH inductor

Semiconductors

IC1	555
Q1	D40D5 power npn or BDV65V
TR1	ultrasonic piezo transducer

Miscellaneous

pc board; wire mesh; D battery and clip; push-button switch; 110 x 6 x 30 mm box hook-up wire.

This project was provided by SYM Electronics (03) 500-0078. and is available in kit or completed form.

Andrew Morton & Paul Berger Part 4

16-BIT COMPUTER

In this fourth article of this series we examine the operations of the 1616 computer and assess its viability in the market place.

SO FAR IN our series of articles about the 1616 we have completed the discussion of the design philosophy, the description of the electronics and the construction details. The discussion of the computer's software commenced last month and now continues, with introductions to the 1616's documentation, the 1616/OS commands, the screen editor, the assembler, and operating system calls.

Software development

An important consideration in the design of the 1616's operating system software was to encourage the development or adaptation of application programs by third party programmers, either professional or enthusiast, for sale or distribution to 1616 owners. What programmers need to bring this about are programming tools and documentation.

The 1616's documentation covers 206 pages and includes:

★ The construction manual (59 pages): a step-by-step guide to the construction of the 1616 and description of the 1616 circuitry, connectors, cabling, and the MC6800 bus, with schematic diagrams.

★ The 1616/OS User's Manual (50 pages): discussion and documentation of the use of 1616/OS and its commands, including the line editor, the screen editor, disk files, I/O redirection, shell (batch) file programming, etc.

★ The 1616/OS Programmer's manual (55 pages): description of the general approach to developing 1616 programs and the resources available to application programs, including the operating system calls.

★ The 1616 assembler manual (42 pages): all about the use of this MC68000 assembler.

The 1616/OS commands

There are 50 commands which are recognized and executed by 1616/OS. Because the actual MC68000 programs which these commands invoke are contained within 1616/OS these are called 'inbuilt' commands. Programs which are loaded from disk (or RAM disk) and executed are called 'transient' programs because they need only exist in memory as long as they are running, after which they may be overwritten.

EDIT: The 1616 screen editor

EDIT, the 1616/OS inbuilt screen editor has been written so that its commands are compatible with the single line editor which is used for 1616/OS command entry.

The editor is used to read in, modify and then write out a disk-based file. It is very similar to MicroPro's popular 'Wordstar' program in non-document mode. Like virtually all the resources of 1616/OS, the screen editor is accessible from within application programs and it is capable of operating within screen 'windows', so the standard screen editor may be integrated into another program running in the 1616.

The command to enter the editor is:

EDIT FILENAME 7

The optional number after the file name specifies the width of the editor's tab stops. With heavily indented files it is sometimes useful to reduce the tab stop width from the default of eight.

Once within the editor you are presented with a status line at the top of the screen. It shows status information, the current position within the file and the name of the current file. This line is also used for prompts during file access, searching and substituting.

The editor's commands are control characters, or characters preceded by a control-Q (▲Q) or a control-K (▲K). The editor's commands may be categorized as follows:

Cursor movement

The cursor movement commands allow you to display and/or alter different parts of the text file by moving to different positions within it.

▲E	up one line
▲QE	up to top of page
▲R	up one page
▲QR	to start of file
▲D	right one character
▲F	right one word
▲QD	right 80 characters
▲B	start/end of line
▲X	down one line
▲QX	down to bottom of page
▲C	down one page
▲QC	to end of file
▲S	left one character
▲A	left one word
▲QS	left 80 characters

Scrolling

The scroll commands move the screen display without altering the relative cursor position. Handy when you are used to them.

▲Z	scroll up
▲W	scroll down

Text deletion

There are a number of commands for deleting ranges of text before or after the cursor.

▲G	delete char forward
▲T	delete word forward
▲QY	delete line forward
H,DEL,BS	delete char backward
▲Y	delete line
▲V	delete line backwards

Block commands

The block commands are used by marking out the beginning and end of a 'block' of text (which is then highlighted on the screen) and then manipulating this block as a whole.

▲KB	mark block start
▲KK	mark block end
▲KY	delete marked block
▲KH	hide block
▲KW	write block to file
▲QB	go to block start
▲QK	go to block end
▲KV	move marked block to cursor
▲KC	copy marked block to cursor

File commands

Various file I/O commands and system access commands are available from within ▶

ASSEMBLER MACROS

An assembler macro is a prototype of a sequence of assembler instructions which is defined in your source file. You give the prototype a name when defining it and henceforth whenever this name is used as an assembly source instruction the macro's prototype is expanded out and assembled. Using a macro as an instruction in this manner is known as a 'macro invocation'. A macro invocation statement usually includes operands which modify the way in which the macro is expanded.

Macros are simply a fancy text substitution mechanism; there are various ways of controlling how the substitution occurs, and the eventual output is machine language source containing no macro invocations.

As an example, let us consider a section of 1616 assembler code which draws a diagonal line across the VDU screen:

```
move.l  #0,d1    * x start
move.l  #0,d2    * y start
move.l  #639,a0  * x end
move.l  #199,a1  * y end
move.l  #53,d0   * line draw system
                   call number
trap    #7       * perform the system
                   call
```

A preferable approach to this is to use macros as follows:

```
drawline macro      * macro prototype
                      definition
move.l   1,d0       * x start
move.l   2,d2       * y start
move.l   3,a0       * x end
move.l   4,a1       * y end
moveq.l #53,d0      * call number
trap     #7
endm
```

Note that this macro produces no code output when its prototype is defined. We first need to invoke the macro, as follows:

```
drawline #0,#0,#639,#199
```

When this invocation is expanded out, each of the operands is slotted into the appropriate place in the prototype and the resulting text is assembled. Macros may be nested, which means that a macro prototype definition may include invocations of other macros.

the editor.

▲KR	read in (merge) a file
▲KX	write out file, quit
▲KD	write out file, continue editing

Miscellaneous

The miscellaneous commands include setting and moving to file markers, merging files, partial screen freezing, etc.

▲KQ	exit without saving file
▲KE	execute a 1616/OS command
▲QG	go to line number
▲KF	partial screen freeze
▲QF	find pattern
▲L	repeat last pattern find
▲KI	escape to 1616/OS
▲KO- K9	set block markers 0 to 9
▲QO- Q9	go to a block marker
▲QA	substitute pattern
▲N	repeat last substitution

The partial screen freeze feature (▲KF) allows you to display part of the current file on the screen whilst editing a different part. This proves very useful for program editing.

The ▲KI and ▲KE commands are particularly useful. They allow you to temporarily leave EDIT and execute a 1616/OS command(s). For instance, you may be editing an assembler source file, temporarily leave the editor and assemble it, then return to the editor exactly where you left off.

System calls

Application programs have available around 100 1616/OS internal functions, many of which have several modes of operation. The process of calling one of these functions is referred to as a 'system call'.

The available system calls are divided into the following broad categories:

System control:

These functions alter the configuration of the 1616 or call general purpose internal 1616/OS routines.

Character I/O:

The character I/O functions perform input, output and status calls on character device drivers.

File I/O

These functions include all the standard file control routines as well as block device driver calls.

Video control:

The video control functions include the simple calls to change colours, etc, as well as the text/graphics window control functions.

Graphics:

The graphics functions are related to the video functions, particularly where windows are defined.

Hardware control:

There are a number of system calls which manipulate I/O devices. Use these wherever possible, rather than directly manipulating I/O devices.

A system call is performed by putting the call number into d0 (data register zero) and any required arguments into d1, d2, a0, a1 and a2 and then executing the 68000 'TRAP #7' instruction. If the system call does not require five arguments then not all of these registers need be initialized.

Any return value from the system call will be in d0. If the system call does not return a value then the contents of d0 are undefined. All system calls preserve all registers except d0, however, it is poor programming practice to reply upon this. All parameters passed to system calls are considered to be long integers (32-bit quantities). The returned value is also a long.

Normal 1616 programs will make extensive use of system calls; for this reason an assembler macro package which greatly simplifies the use of system calls comes with the 1616 assembler. An example of a system call is given below.

IN-BUILT COMMANDS

The in-built commands are all listed here as a guide to the features of 1616/OS.

MEMORY MANIPULATION COMMANDS

MDB, MDW, MDL: memory dump byte, word, long
MRDB, MRDW, MRDL: memory repetitively dump byte, word, long
MWB, MWW, MWL, MWA, MWAZ: memory write byte, word, long, ASCII, nul-terminated ASCII
MFB, MFW, MFL, MFA: memory fill byte, word, long, ASCII
MCMP: compare memory blocks
MSEARCH: search memory for byte pattern
MMOVE: memory block move
MSAVE: save memory on disk file
MLOAD: load disk file into memory

DISK FILE COMMANDS

CHTYPE: change the type of file(s)
COPY: copy and/or join files
DELETE: delete file(s)
DIR, DIRS: directory listing
RENAME: change a file's name
LOG: log onto a new block device

CASSETTE TAPE COMMANDS

TSAVE: save disk file(s) on tape
TARCHIVE: save changed disk files on tape
TLOAD: load a file from tape
ITLOAD: load all files from tape
TVERIFY: verify all files on tape

MISCELLANEOUS COMMANDS

BASE: convert number(s) to and from binary, decimal or hex
EXPR: evaluate an arithmetic expression
CIO: copy characters from standard input to standard output
ECHO: echo command line arguments onto standard output
EDIT: edit a file
FKEY: reprogram a function key
GO: execute a machine language program
HELP: obtain help about in-built commands
PAUSE: temporarily suspend command processing
QUIT: exit from command interpreter
SERIAL: reprogram a serial port
SETDATE: set current date/time
SREC: load S-records
SSIO: reassign standard input/output devices
SYSCALL: manually perform a system call
TERMA, TERMB: enter serial terminal mode
DATE: display current time/date

The 1616 assembler: SSASM

The 1616 assembler is supplied on tape with the 1616 system. The assembler was written by David Farb of Farbware, Illinois and it was adapted to the 1616/OS environment by Andrew Morton of Applix. SSASM is a two-pass assembler which reads in a source file which contains standard Motorola MC68000 machine code mnemonics and writes out an executable program file. Source files may be produced using the 1616/OS editor.

The assembler supports the use of 'include files', which are disk files which contain common storage definitions, label assignments or macro definitions which may be included in programs at assembly time.

thus reducing file sizes and promoting consistency in the use of labels and macros. Conditional assembly is also there; the assembler has pseudo-instructions which may be used to control whether or not sections of code should be assembled.

SSASM also sports that most useful feature: assembly macros (see box). There is a file supplied with SSASM which contains macro code for performing each of 1616/OS's 100-odd system calls. This file may be 'included' in other programs so that the programmer can encode system calls in a quicker, more readable and less error-prone manner. The SSASM tape includes some demonstration programs which show the use of the assembler, system calls and the system call macro include file.

1616 Programming

It is desirable that 1616 programs blend into the 1616/OS environment by working in a standard, predictable manner. The program conventions which should be observed are:

(1) Programs should, where possible, obtain their user-provided information from the command line arguments.

(2) If a program detects an error on the command line it should print out a usage message in a standard format.

(3) Programs should not produce unnecessary output. Programs which display copyright messages, programmer's names, version numbers, etc, are often awkward to use in an operating system with the I/O redirection features of 1616/OS.

The standard start address for programs is $4000, however programs may be loaded in at higher addresses. The arguments which were typed on the command line when a program is run are accessible from within that program. These arguments are such things as file names, option selections, numeric data, etc.

A program has available to it all of the memory from $4000 to the bottom of the machine stack. The amount of available memory depends upon the selected RAM disk size. The usual free memory size is 1/4 of a megabyte.

1616 memory usage

The memory usage map for a 1616 with a 256K RAM disk selected is as follows:

$00000-$003FF machine vector table and some system use
$00400-$033ff 1616/OS internal data areas
$03400-$03bff unused, free for application programs
$03c00-$03fff unused, reserved by Applix
$04000-$03fe00 (approx) application program code, data and stack areas
$40000-$41fff 1616/OS file buffer area
$42000-$7ffff RAM disk storage area and checksum tables ●

1616: THE FUTURE

The first and most obvious question everyone has asked when enquiring about or purchasing the 1616 is "when will the disk controller be available?". The answer is, very soon. We have already started work on the controller and will have some definite details, pricing, etc, in the next article.

You must keep in mind that these articles are written six to eight weeks in advance of publishing. As this is being written in early February, it is highly probable that by the time the article is in print a demonstrable prototype will be up and running. Thus if your curiosity gets the better of you, contact Applix directly.

SOFTWARE:

Again, by the time you read this article, a full featued BASIC interpreter will be available. This will run on both tape- and disk-based systems and will cost around $50.

What about disk operating systems? A new release of 1616/OS will be supplied with the disk controller. This is simply a matter of adding a block device driver but we will also be adding some more features. Any programs developed on tape can be simply loaded into the RAM disk and transferred to disk. We are looking at porting a full C compiler to 1616/OS.

Applix will be endeavouring to port Digital Research's GEM operating system to the 1616. Briefly, GEM is a window-based operating system very similar to that on Apple's Macintosh. This is the same operating system as the Atari ST series uses, and will allow the 1616 to run many of the commercial software packages available for that machine including many programming languages.

We have a number of third party developers looking at porting Microware's OS-9 operating system and also Whitesmith's UNIX look-alike, IDRIS to the 1616.

WHO'S BUYING THE 1616?

We were astounded by the variety of people interested in the 1616, and expect to reach our target of 500 units shortly. The more people who buy it, the more opportunity we have to develop new products for it, the better it will be for everyone.

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Any hardware or software developers interested in doing work with the 1616 should contact Applix. We are willing to offer any help or advice to get new products off the ground and to discuss marketing opportunities.

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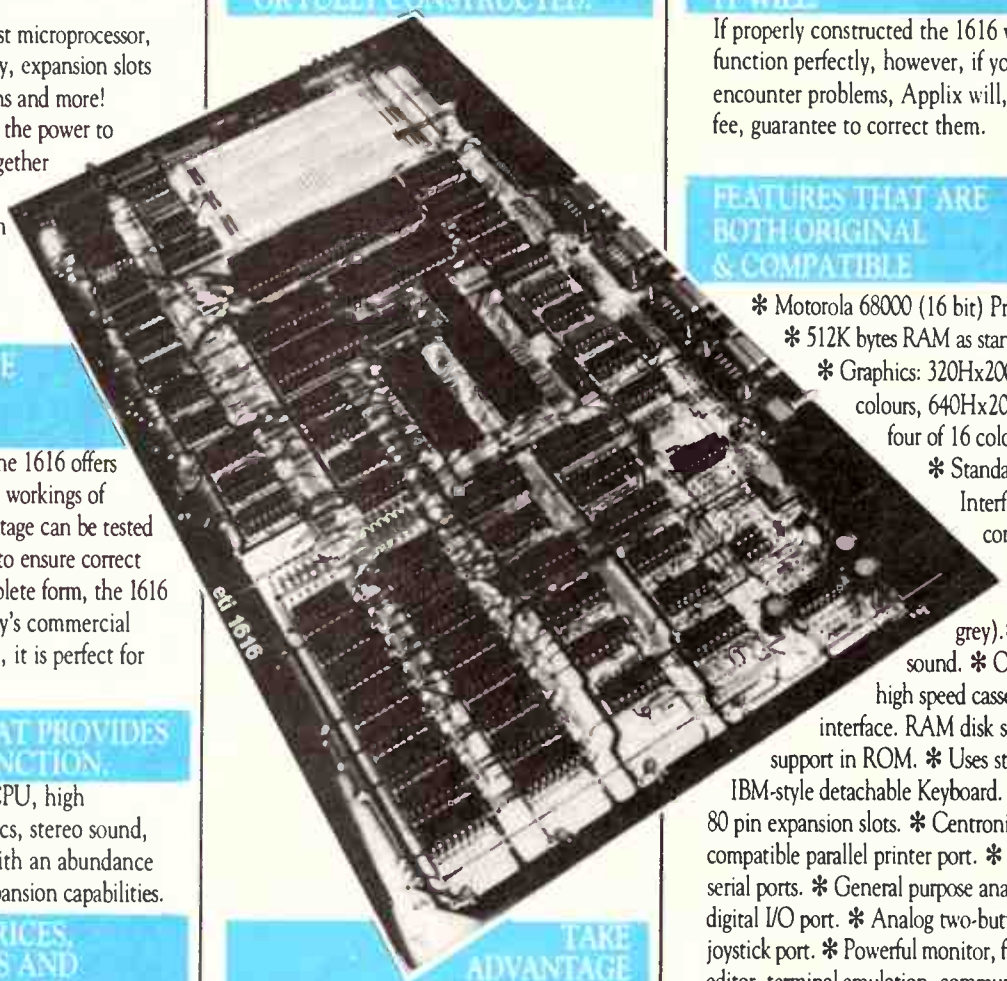

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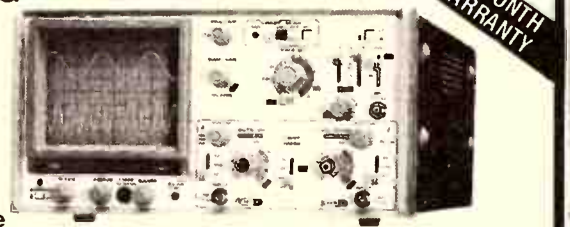

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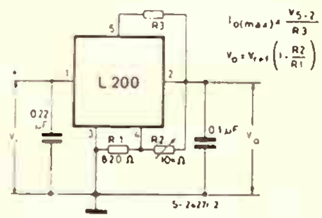

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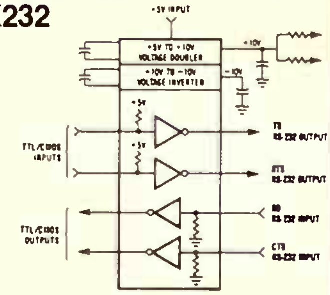

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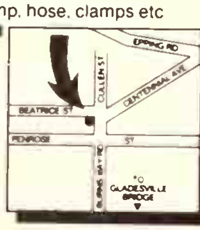

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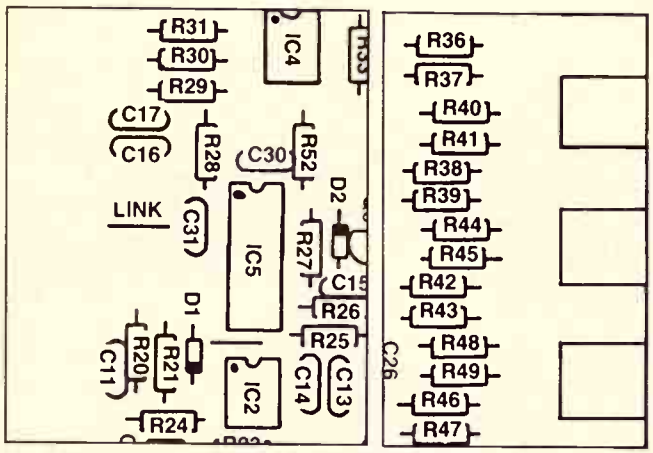
NOTES & ERRATA

Project 142, dc Power Supply, February 1979: The circuit and wiring diagrams for this project contain a mistake that all builders should be aware of — even at this late stage. Wires from the transformer T1 (PF4244 240V/32V 300 VA) are incorrectly labelled orange and white on the circuit. They should be transposed so that 'orange' should connect to the rectifier rather than 'white' as is shown, and 'white' should connect to the circuit board instead of 'orange'.



Project 169, Low distortion audio oscillator Pt 2, November '85: Resistors, R38-R49, are labelled incorrectly on the overlay. The right ordering is reprinted herewith. Also on the overlay, the pc board track from pin 2 IC3 was shown leading to pin 16 IC5. Rather it should lead to pin 15 IC5. To correct this, cut the track from pin 2 IC3 at pin 16 IC5, and attach fly wire between the cut track and pin 15 of IC5. The correct layout is also reproduced.

Project 170, Precision CRO calibrator, Feb '85: In order to make the attenuators conform to the front panel artwork, use the following resistor values: R=220R, R18=330R, R22=22R, R23=33R, R29=220R, R30=330R, R34=22R, R35=33R.

Project 284, VCR alarm, Nov '86: The piezo electro transducer specified for this project also includes an oscillator in one package. We used Dick Smith Part No L7024 in the prototype. L7027 may also be used with a 2k7 resistor in parallel.

Project 1402, Digital sampler, May '86: Resistors mentioned in the Parts List as 5% should be 2% and those marked as 2% should be 5%. The standby power supply VA mentioned at the end of the How It Works should be in house style reading V_{GG} as in the circuit diagram. On the wiring diagram, the trigger switch is labelled incorrectly: terminal lettering F should read J and vice versa.

Project 687, VZ200 modification, July '86: Pin nos 4 and 5 of IC1 were transposed.

Project 689, Bus sharing for the Commodore, January '86: Diode D3, on the overlay should read ZD1 as per the parts list.

Project 751, Miniature FM transmitter, December '85: What could go wrong with this one? A typo. The equation for the turns ratio in the How it works section (p 50) should be: $N = k\sqrt{\frac{Ri}{Ro}}$

The little electric store, Sept '85: The caption of Figure 1 should read: 'The elliptical path of an electron around the nucleus in an electric field'. Figure 2 was placed on the page, rotated through 90°. Alternatively, read 'horizontal' for 'vertical and 'vertical' for 'horizontal' in the caption.

1986 ETI reference section, Jan '86 & Starting Electronics 13, April '86: The pin connection package illustrated for the 7900 series regulator is incorrectly labelled. The correct package is reproduced below.

Ideas for experimenters, Camera timer, April '86: We advise that this circuit will work better if the positive rail is connected to the centre switch, SW3.

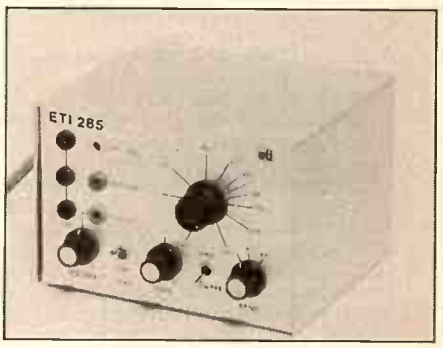
Ideas for Experimenters, Current feedback for drill control, August, '86: Beware: the earth and neutral labels were transposed on the circuit diagram we published. Earth is actually the lead connected to the case with the ground symbol attached. Neutral is the one above.

TEACH YOURSELF

CREATING WITH ELECTRONICS 5

OSCILLATORS AND AMPLIFIERS

If you're looking for a versatile low cost audio test station, try this one. We present a multipurpose, all singin', all dancin' combination audio oscillator, signal tracer, audio transducer tester, etc, etc, that's designed to fit into the standard case. Included in this article is some backup theory on op-amps and Wien bridge oscillators, for your further enlightenment of linear electronics.



Peter Phillips

Part 3

Last month we presented an amplifier as a project for this series. In case you thought an audio oscillator should have been produced first, we now cover all bases by offering them both together. This project combines, on the one printed circuit board, a sine-square audio oscillator and a 2 watt audio amplifier module. The whole lot fits into the same size case as the regulated power supply described in part 2 (Nov '86) and provides a complete audio test station. It is intended that all projects for the series will use this size case, providing a lineup of useful test equipment that looks the part. Next month's design is an analogue frequency meter, and other similar items will follow.

The amplifier can serve as a signal tracer, a speaker, microphone or pickup tester, and can also boost the signal output of the audio oscillator to around 12 volts peak-to-peak. The oscillator is a sine-square Wien bridge circuit with a frequency range of 23 Hz to 23 kHz. The circuit is interesting in that no hard-to-get stabilizing thermistor is required, and it uses garden variety operational amplifiers without the need for a dual polarity power supply. The pcb layout is arranged so that either one or both sections can be built, and the oscillator circuit is simple enough to be constructed on vero board if desired.

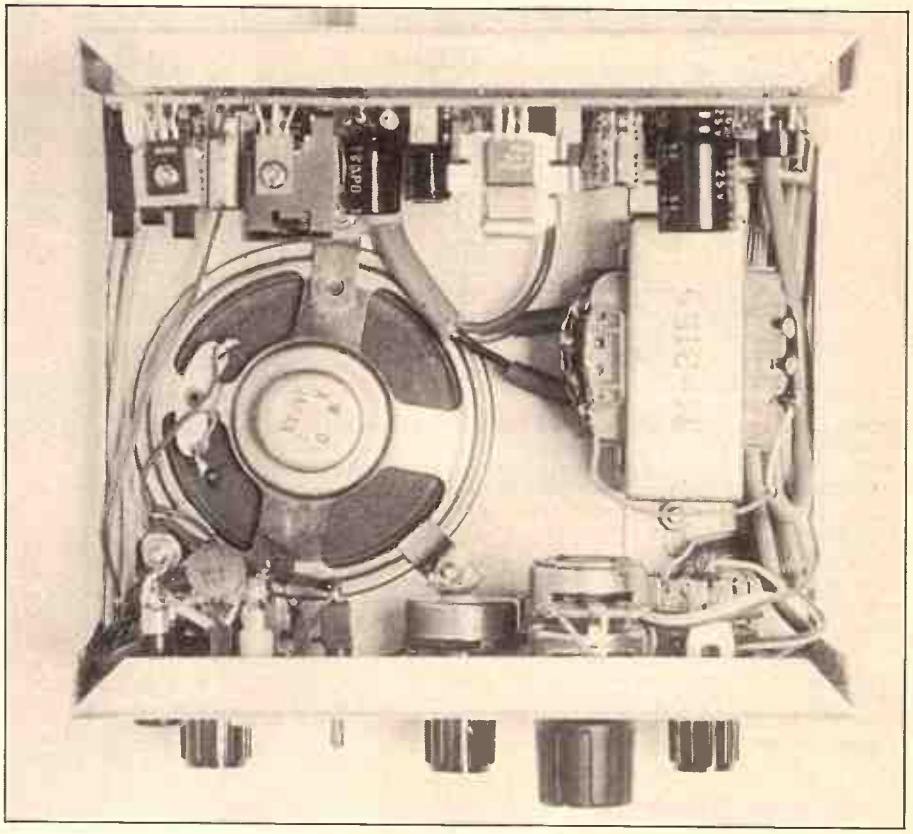
Because of the instructional nature of this series, the operational amplifier is discussed, along with a description of the Wien bridge audio oscillator. The amplifier section was described fully last month, and readers can refer back for full details of its operation and circuit description.

The circuit

Figure 1 shows a block diagram of the complete unit including the relationship of the controls. The principles of an oscillator were covered previously in CWE 3 (Feb '87), and it remains to discuss actual circuits. Summarizing, an oscillator, as shown in Figure 2, is an amplifier with both positive and negative feedback that cancel each other at a specific frequency. By making the characteristics of the positive feedback circuit variable, a frequency adjustable sine-wave oscillator is achieved.

The design provides three decades to cover the frequencies from 23 Hz to 23 kHz. A decade change means the preset frequency has been altered by a factor of 10, either increasing or decreasing. Variations from 23 Hz to 230 Hz are covered by the lowest range, 230 Hz to 2.3 kHz and 2.3 kHz to 23 kHz by the other two. Most professional audio oscillators cover four or five decades, but are more complex and costly. As later described, it is possible to add another dec-

Looking down on the innards.



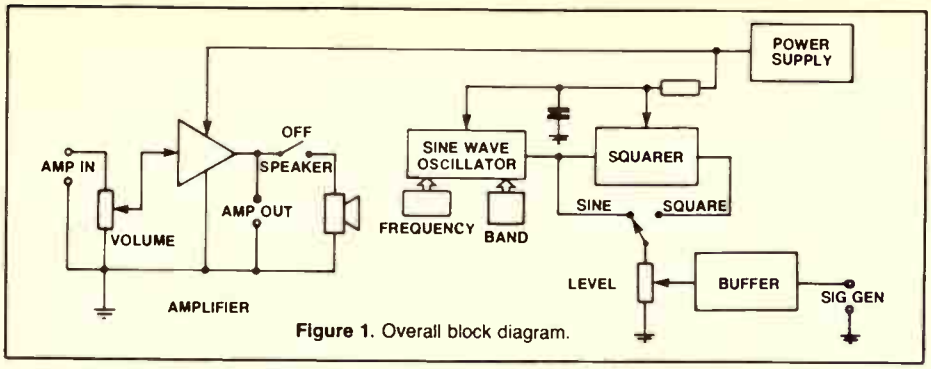
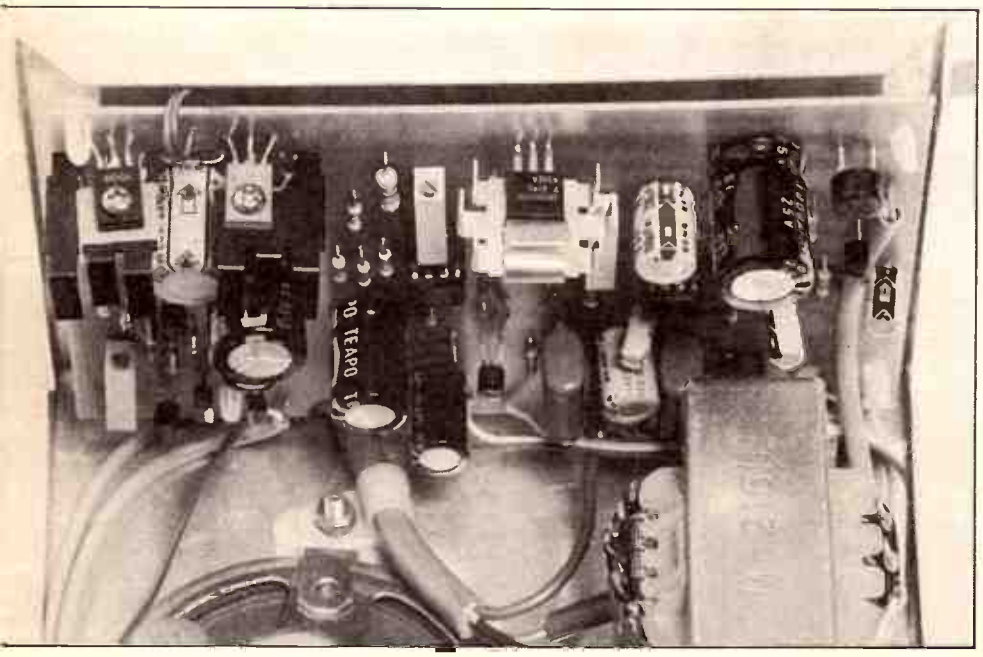


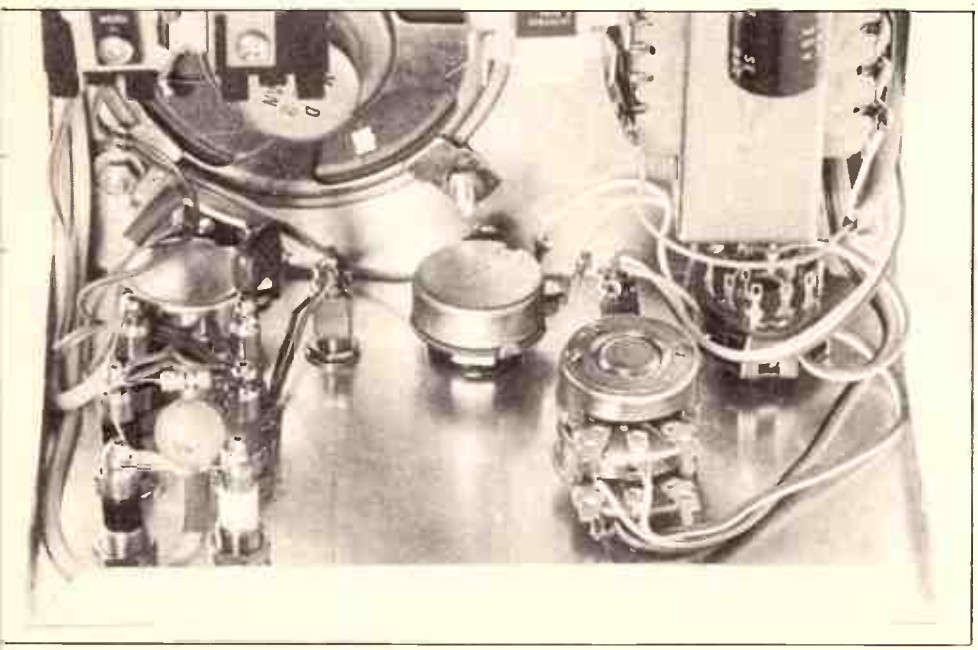
Figure 1. Overall block diagram.

ade, but due to the limitations of the op-amp, scale accuracy suffers. The project is intended to be simple yet versatile, and overcoming this problem would mean the abandonment of the amplifier module as an integral component due to space limitations. However, if the forthcoming frequency meter is built, the scale inaccuracies won't matter.

Two operational amplifiers are used, one for the oscillator, the other for the squarer. An understanding of op-amps is essential for the circuit description to be meaningful, and a brief discussion of these versatile devices is included along with the principles of the Wien bridge oscillator.



Above: The rear of the box showing amp to left, oscillator to right. **Below:** Rear of the front panel.



At this stage, a quick scan of the contents of CWE 3 (Feb '87) is advised to refresh your memory on feedback.

The op-amp

Operational amplifiers are available as ICs in a wide range of type numbers. They all differ in some respects, but have one thing in common: a very high open loop gain. When an amplifier of any type has a high gain, the external feedback networks determine the circuit's operation. It is valid to assume that an op-amp has an infinitely high gain, which means that it can be ignored as a device, and the circuit viewed as a whole. Amplifier circuits incorporating op-amps require the gain to be reduced by *negative* external feedback. Figure 3 shows two circuits: (a) of an inverting amplifier where the output signal is of opposite phase or polarity to the input, and (b) where they are in phase.

The feedback network in both cases is made up of two resistors, R_f and R_1, connected from the output terminal back to the *inverting* (−) input, providing negative feedback. Connection to the non-inverting (+) terminal would result in positive feedback. The gain and input resistance equations are also shown for both circuits. Notice how the input resistance for the non-inverting circuit is infinity (ideal value only, lower in practice); a useful feature if the application requires a high input resistance. Establishing the gain for both circuits merely requires the selection of suitable resistance values. Usually R_f has a maximum value of 1M ohm.

Becuse the op-amp has such a high gain, the input voltage V_d (difference voltage), at the actual input terminals of the IC is negligible. This means that for circuits that use negative feedback, the dc voltage or waveform is the same at both inputs, an important point to remember when fault finding. Op-amps generally utilize a *dual polarity* power supply, obtainable from two batteries or power supplies as shown in Figure 3(c). This is necessary as the internal circuitry of the device is direct coupled, and allows the output waveform to swing both positive and negative. A dc path to ground must also be provided for the small bias currents flowing from both IC inputs.

Not all op-amp circuits use negative ▶

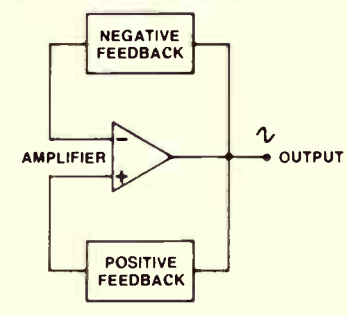


Figure 2. Block diagram of a Wien bridge oscillator.

feedback. The notable exception is the comparator circuit, which needs a very high gain. Figure 4 shows the basic circuit, which rates as the simplest op-amp circuit of all. Again a dual polarity power supply is shown, with two input signals labelled V_1 and V_2. The output of a comparator is always one of two values, called $-V_{sat}$ and $+V_{sat}$. V_{sat} (saturation) is nearly equal to the supply voltage, either positive or negative, depending on the polarity of the output. If V_1 is greater than V_2 (more positive than), the output will saturate in the negative direction, to a value determined by the power supply. Figure 4(b) shows the output waveform when a sine wave is applied to one input and a fixed dc value to the other. Now you know how the squarer circuit of the project works.

There are numerous applications for op-amps, and whole text books have been written on the topic. The current project has the interesting twist in that a single polarity power supply is used throughout, by using input biasing techniques.

The Wien bridge oscillator

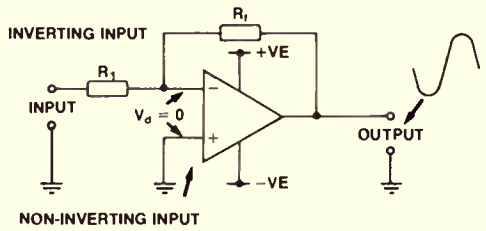
The Wien bridge oscillator doesn't necessarily need an op-amp, and many discrete component circuits have been published. However, by using an op-amp, physical size of the circuit layout is reduced, and in this case offers a good excuse for their introduction.

Figure 2 shows the general block diagram of any Wien bridge oscillator circuit, without showing where the 'bridge' bit comes in. Figure 5 is a basic circuit diagram, drawn to show how the two feedback legs represent the classic diamond or bridge configuration. The negative feedback is provided by R_f and R_i as for Figure 3(a), and the positive feedback incorporates a series and a parallel RC circuit. Because of the RC circuits, the feedback will be exactly positive only at a specific frequency, determined from equation 1.

$$F_{osc} = \frac{1}{2\pi RC} \text{ Hz} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

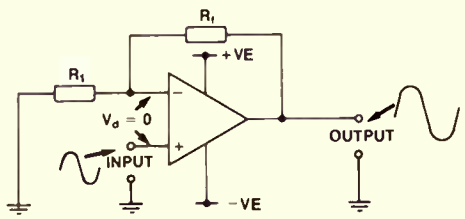
This equation assumes equal values for both RC legs which is necessary for the Wien bridge's operation anyway. The positive feedback network is frequency sensitive because the *impedance* of a capacitor varies inversely with frequency. This variation of impedance also causes a change in the *phase* difference of the signals either side of the capacitor. At one frequency only, the waveform at the positive terminal of the amplifier will be exactly in phase with the output waveform, causing positive feedback. Also, the signal level at this input will be one third the amplitude of the output signal. To compensate, the gain of the amplifier must equal 3, set by the negative feedback, therefore, giving a combined loop gain of unity (or 1). Too little gain prevents oscillation, too much produces a distorted output.

Figure 5 is a 'bare bones' circuit, and needs more sophistication to be practical. The first difficulty to overcome is maintaining the overall loop gain at unity. Practical circuits often use a temperature sensitive resistor (thermistor) for R_f, which serves to correct for variations in the amplitude of the output waveform. The project uses a dc controlled FET, the advantages of which include the cost/availability factor. Another advantage is the settling time. In thermistor-based circuits, range changing can often lead to output



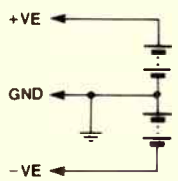
VOLTAGE GAIN (A_v) = $\frac{R_f}{R_1}$ (a) THE INVERTING AMPLIFIER

INPUT RESISTANCE (R_{in}) = R_1



VOLTAGE GAIN (A_v) = $\frac{R_f}{R_1} + 1$ (b) THE NON-INVERTING AMPLIFIER

INPUT RESISTANCE (R_{in}) = infinity (open circuit)



(c) DUAL POLARITY POWER SUPPLY

Figure 3. The operational amplifier.

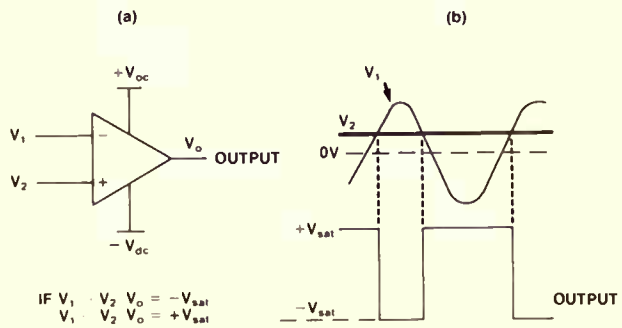


Figure 4. The comparator.

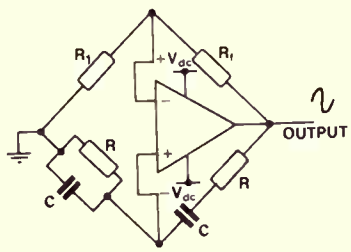


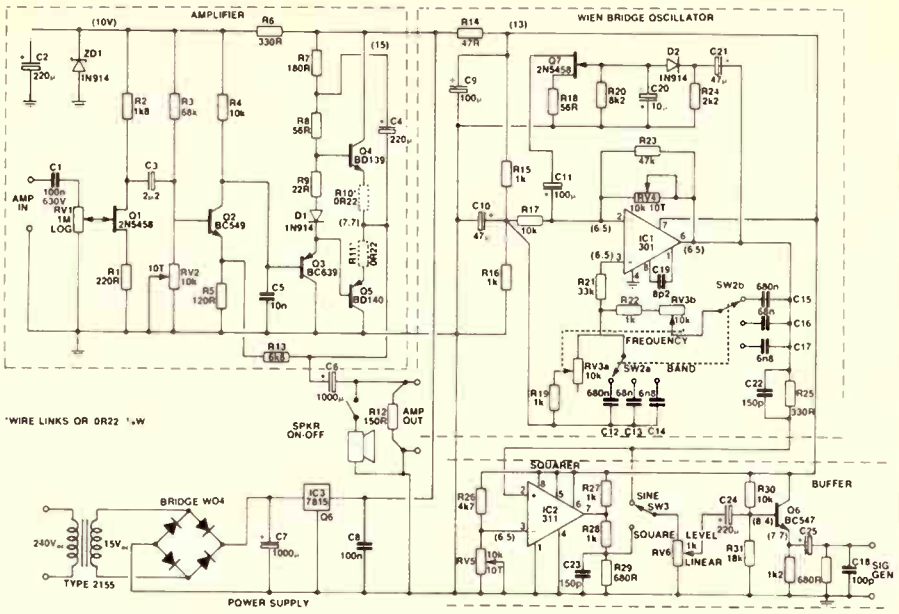
Figure 5. The Wien bridge oscillator.

ETI-285 — HOW IT WORKS

The circuit diagram is shown divided into four blocks. The amplifier section is virtually identical to that described last month. The minor differences are caused by the use of a regulated 15 V power supply, resulting in slight variations to component sizes. A notable difference is the omission of an adjustment within the biasing network for the output transistors of the amplifier. The previously used variable resistor has been replaced with a fixed value resistor, R9, eliminating the need to perform any set-up adjustments for the biasing. Should cross-over distortion be present, increase this resistor value. The input coupling capacitor C1 should have a 630 volt rating for maximum protection when using the amplifier as a signal tracer. R12 is a load for the amplifier if the speaker is switched off, and is mounted across the output terminals.

The Wien bridge oscillator section is based on a 301 op-amp. This device requires external frequency compensation, achieved by C19. To allow the use of a single rail power supply, the inputs are biased at half the supply voltage, provided by R15, R16 and C10. The positive feedback network comprises the six capacitors, C12 to C17, selected in pairs by SW3, the dual-ganged linear potentiometer RV3 and resistors R19 and R22. The capacitors should ideally be chosen by measurement to ensure each range varies by exactly 10. R21 ensures that the dc resistance from pin 3 to ground roughly equals that from pin 2 to ground, minimizing offset errors resulting from the dc voltages developed by the internal bias currents from the IC.

The negative feedback loop must ensure a constant gain of 3 over the entire range and control is provided by the FET Q7. C2 couples the signal to D1, blocking the dc voltage present at the output. The signal developed across R24 is rectified and smoothed by D1 and C20. R20 is a load across C20 to give a fast response and also connects the gate of Q7 to ground. A negative voltage is therefore produced at the gate terminal that varies the resistance of the FET proportionally. C11 couples the drain of the FET to the inverting input of the amplifier IC1. The impedance of the path made up of C11, R18 and the source-drain resistance of the FET is the variable controlled by the output signal that maintains the output at the present level. RV4 and R23 also provide negative feedback, and RV4 is the adjustment to get the controlled feedback into its working range.



The output signal of the oscillator is coupled via R25 and the parallel capacitor C22 to the selector switch SW3 and the input of the comparator IC2. This IC is a 311 comparator, operating from a single rail power supply. A dc reference voltage is established by the potential divider R26 and RV5 at the inverting input of the comparator. A symmetrical square wave is obtained by adjusting RV5. The output of the comparator is attenuated by R28 and R29 to equal that of the sine wave. R27 is a pull-up resistor for the open-collector output of the 311.

The selected waveform is coupled to the level control RV6 which has its wiper ac coupled by C24 to the emitter follower, Q6. This amplifier has a gain of 1, and acts as a buffer, giving an output impedance for the generator of around 150 ohms. C25 isolates the dc voltage at the emitter of Q6 from the output terminals. The capacitors C22, C23 and C18 all serve to clean up the square wave by removing ringing effects and overshoot caused by the fast switching characteristics of the 311 comparator. C18 is mounted across the output terminals of the signal generator.

The power supply is regulated by the three terminal regulator IC3 to provide 15 volts dc. Decoupling is provided between the amplifier section and the oscillator section by R14 and C9. Further decoupling is also provided with the amplifier via R6 and C2. C8 improves the response of the regulator.

waveform 'bounce', requiring up to several seconds before the level stabilizes.

The next modification to Figure 5 is to make the frequency variable. This is done both by altering the value of R with a dual-ganged potentiometer, and the value of C using a two-way multiple switch to select various capacitance values. The range is selected by switching a new value of C into both legs, and the frequency within the range by adjusting R simultaneously in both legs. The project uses a dual-ganged 10k linear pot to adjust the frequency, and a wafer switch to select a capacitor pair. Because the frequency varies *inversely* with the value of R, a non-linear relationship exists, giving a cramped frequency scale at the high end of the range; a characteristic of the Wien bridge oscillator.

ETI-285—SPECIFICATIONS

AMPLIFIER

Maximum output power (1 kHz): 2 W_{rms} (8 ohm resistive load)
Maximum output voltage: 13 $volts_{p-p}$ (150 ohm resistive load)
Voltage in for full output power: 190 mV_{p-p}
Voltage gain: 60 (35 dB)
Bandwidth: 24 Hz to 180 kHz (8 ohm resistive load)
Input impedance: 1M ohm
Efficiency: 51% (I_{CO} set at 100 mA)

OSCILLATOR

Waveforms: sine and square
Frequency range: 23 Hz to 23 kHz, three ranges
Output impedence: 150 ohms approx
Output voltage: 2 $volt_{p-p}$
Output voltage variation over range: −5%, +12%

Construction

This project is more complex than previous ones in the series, but readers can simplify it if required. The circuit for the oscillator could be constructed on vero board if necessary, and the amplifier section deleted. The pcb layout is arranged so that the two sections are separate, giving flexibility to suit individual needs. Before mounting any components, prepare the board by drilling the mounting holes to suit the standoffs being used. The case should also be drilled for these, using the pcb as a template. The 240 volt lead will require filing a semicircle out of the pcb at the point shown on the layout diagram. The rest of the case can now be prepared by drilling all holes and attaching the front panel (Scotchcal), if being used. Position the transformer to allow room to mount the pcb on the rear of the case and run the 240 volt lead through a grommetted hole, drilled adjacent to the relief filed into the pcb. Insulate the 240 volt connections carefully, and connect the earth lead to a lug held by a transformer mounting bolt. The internal speaker was attached face down in the prototype without drilling any holes for a sound outlet.

Printed circuit board assembly should start by mounting resistors, wire links and diodes, followed by the capacitors and pre-set pots. Finally, connect the semicon- ▶

ductors, *except the output transistors (Q_4 and Q_5) for the amplifier.* IC sockets can be used if desired but are not essential. When all components are soldered in, connect the peripheral switches and potentiometers as detailed by the layout diagram. Rainbow cable is recommended, and should be laid around the edge in a neat run to the front of the case. Concentrate initially on the oscillator section, as it is the more complex, and should be commissioned first.

Commissioning

Once the oscillator circuit is complete, do a final check for shorts and wiring errors, turn RV4 fully clockwise (minimum resistance), then apply power. Measure the dc voltages shown on the circuit for the oscillator section. At this stage it is unlikely the oscillator is working, but if these dc values are correct, it is safe to proceed. If a CRO is available, connect it to monitor the output at pin 6 of IC1. Alternatively, connect a multimeter (either digital or analogue) set to read ac volts, in series with a 1µ capacitor to this pin. Set the band to the lowest range, and the frequency control mid-way to give a frequency of about 40 to 50 Hz. Slowly turn RV4 anticlockwise until an ac reading of around 1 volt rms is obtained (2.8 volts peak-to-peak on a CRO). A low impedance voltmeter may require a higher value of series capacitor. If the specified reading cannot be obtained, try changing the FET as parameter variations between devices of the same type are fairly wide. Note that the 2N5484 type is not suitable.

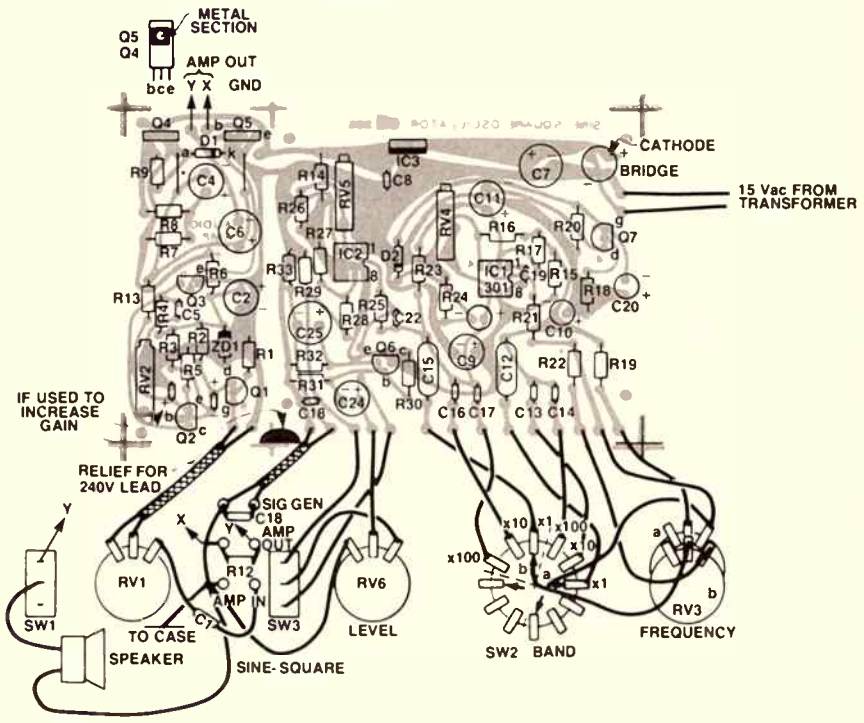
If no reading or display can be obtained, check the circuit for faults. Verify particularly the positioning of polarity-sensitive components, and confirm all external wiring is correct. Otherwise proceed to establish that the buffer stage is working by repeating the measurements at the output terminals. RV4 should now be finally adjusted to give a 2 volt waveform, or approximately 0.7 volts rms (sinewave, level control at maximum). The isolating capacitor for the multimeter will not be necessary.

RV5 can now be set by first adjusting for the dc value shown at pin 3 of IC2. Then using a CRO, adjust RV5 for an equal mark-space for the square wave at the output terminals. If using an ac voltmeter, carefully adjust RV5 to give the highest reading (around 1.1 volts rms). If a CRO is available, confirm that a reasonably constant output level is obtained over the full frequency range for both waveforms. Also, verify the frequency calibrations if possible using a frequency counter. The scale is correct for the 10k linear pot sold by Dick Smith; pots from other sources may give variations to the supplied scale. Decade errors will require checking

PARTS LIST — ETI-285

Resistors ..... all ¼ watt 10% unless noted
- R1 ..... 220R
- R2 ..... 1k8
- R3 ..... 68k
- R4, 17, 30 ..... 10k
- R5 ..... 120R
- R6, 25 ..... 330R
- R7 ..... 180R ½W
- R8 ..... 56R ½W
- R9 ..... 33R
- R10, 11 ..... 0R22 (optional, wire links if unavailable)
- R12 ..... 150R ½W
- R13 ..... 6k8
- R14 ..... 47R ½W
- R15, 16, 19, 22, 27, 28 ..... 1k
- R18 ..... 56R
- R20 ..... 8k2
- R21 ..... 33k
- R23 ..... 47k
- R24 ..... 2k2
- R26 ..... 4k7
- R29, 33 ..... 680R
- R31 ..... 18k
- R32 ..... 1k2
- RV1 ..... 1M ohm log
- RV2, 4, 5 ..... 10k ohm, 10 turn trimpot
- RV3 ..... 10k linear, dual-ganged
- RV6 ..... 1k linear

Capacitors ..... all 25 V electro unless noted
- C1 ..... 100n polyester, 630 V
- C2, 4, 24 ..... 220µ
- C3 ..... 2µ2 tantalum or mono
- C5 ..... 10n ceramic or polyester
- C6, 7 ..... 1000µ
- C8 ..... 100n mono or ceramic
- C9, 11 ..... 100µ
- C10, 21 ..... 47µ
- C12, 15 ..... 680n polyester
- C13, 16 ..... 68n polyester
- C14, 17 ..... 6n8 polyester
- C18 ..... 100p ceramic
- C19 ..... 8p2 ceramic
- C20 ..... 10µ
- C22, 23 ..... 150p ceramic
- C25 ..... 470µ



Semiconductors
- Q1, 7 ..... FET type 2N5458
- Q2 ..... BC549 or similar
- Q3 ..... BC639
- Q4 ..... BD139
- Q5 ..... BD140 (preferably Beta matched to Q4)
- Q6 ..... BC547 or similar
- D1, 2 ..... 1N914 or similar
- ZD1 ..... 1N961 or BZX79 10 V, 400 mW Zener diode
- IC1 ..... 301 op-amp 8-pin DIL
- IC2 ..... 311 comparator, 8-pin DIL
- IC3 ..... 7815 TO-220 regulator
- Bridge ..... WO4 or equiv

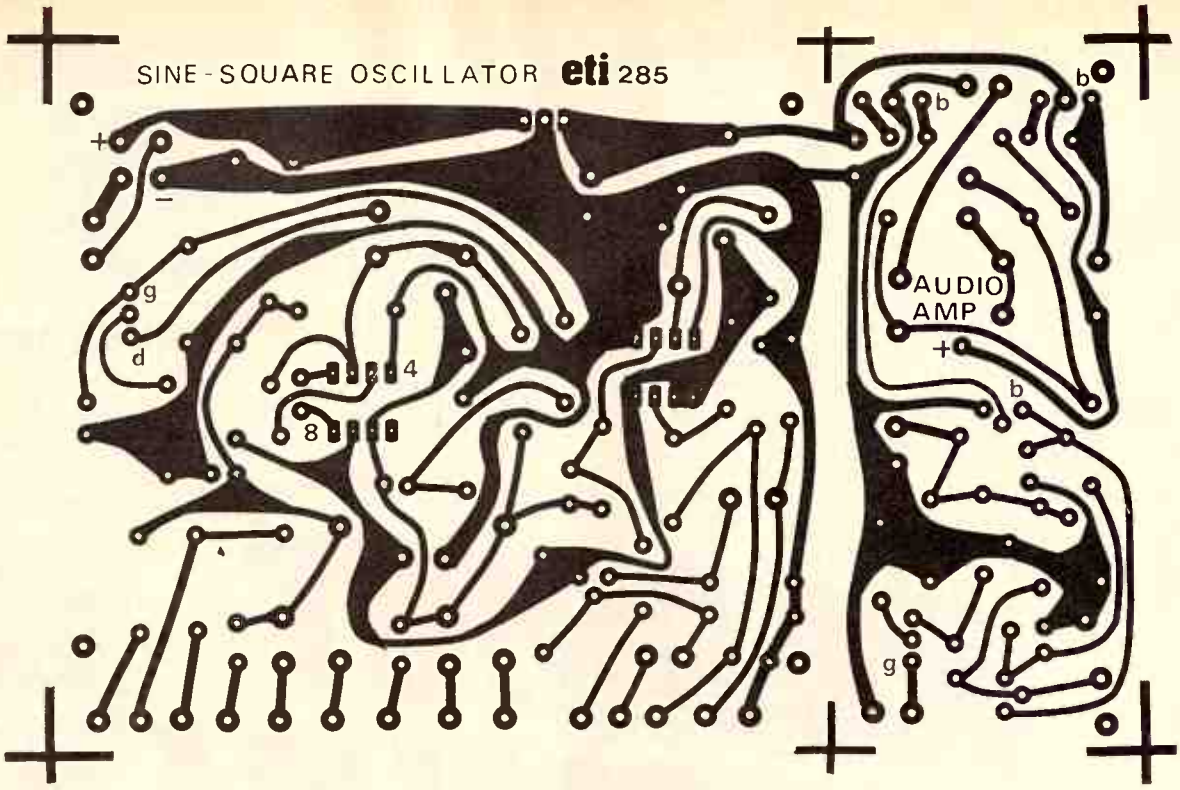
Switches
- SW1, 3 ..... miniature SPDT
- SW3 ..... 2-pole, 3-way wafer

Miscellaneous

pcb or vero board; Scotchcal front panel; aluminium case* 152 (w) x 132 (d) x 103 (h) mm; transformer, 240:15 volt ac 1 amp (eg, type 2155); 6 x 4 mm panel mount sockets, 4 x control knobs; 4 x pcb supports; rainbow cable hook-up wire; coax; 240 V lead and plug; heatsinks; grommet; small speaker, 8 or 15 ohm; nuts and bolts; cable clamp; 2 lugs.

Price estimate: $45-$55

*The case size was based on the Dick Smith case, catalogue no. H-2330. However, although this unit has the same dimensions, a recent discovery shows they are for d x w x h. The larger aluminium case, no. H-2335 can be used if necessary, but the front panel design will need enlarging to suit.

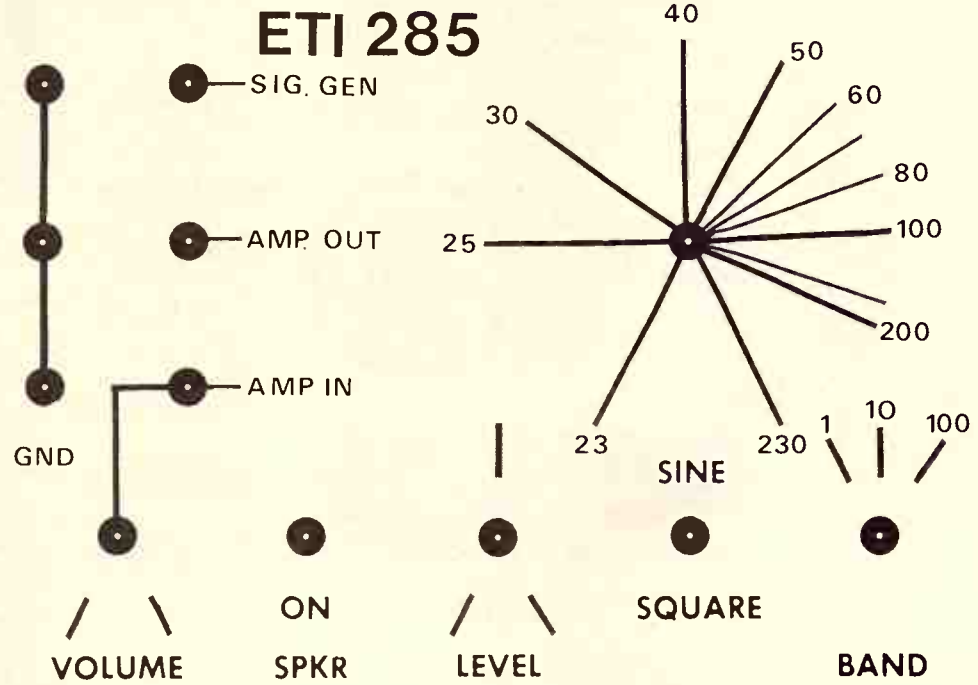


capacitor values for C12 to C17.

An extra decade can be obtained by including two extra band switching capacitors (both 680p) and replacing the wafer switch with a 4-way 2-pole type. The additional components could be mounted on the switch and extra wires run to the pcb. However, the frequency of the output will not agree with the scale for the upper 25 per cent, and the maximum output frequency will be around 180 kHz rather than the theoretical value of 230 kHz.

Once the oscillator is functioning, the amplifier can be commissioned. Full details for this were given last month and only one adjustment is now necessary. Transistors Q4 and Q5 should be now soldered into position, metal face in, and RV2 adjusted to give about 7.7 volts at the emitters.

The whole unit can then be finally assembled. It is important to earth the metal case to the signal common with a connection adjacent to the 4 mm sockets. Also ensure that R12 and C18 are soldered across the appropriate 4 mm front panel sockets. ●



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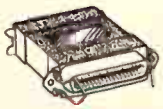

CENTRONICS GENDER CHANGERS

- Female to Female.
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Cat. X15663 **Male to Male**
Cat. X15661 **Male to Female**
Cat. X15664 **Female to Female**
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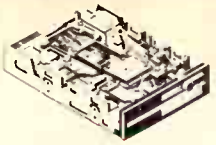

NEC DISK DRIVES

3½" DISK DRIVE

- 1 M/Byte unformatted, (640K formatted).
- Double sided, double density.
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Cat. **$265**

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- AT compatible

Cat. C11906 ..... **$295**

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(AT COMPATIBLE)

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Xidex D/S **$69.95**

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DRIVE CARD
Cat. X17019 ..... **$79**

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Cat. X17025 ..... **$85**

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Cat. X17039 ..... **$79**

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Cat. X17027 ..... **$95**

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- Switch comes standard with female connector

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- Speed and code transparent
- Two/Four position rotary switch on front panel
- Three/Five interface connections on rear panel
- Switch comes standard with female connector
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1-99 DISKS	100+DISKS	1,000+DISKS
$47.50 (PER 10 DISKS)	$45.50 (PER 10 DISKS)	$42.50 (PER 10 DISKS)

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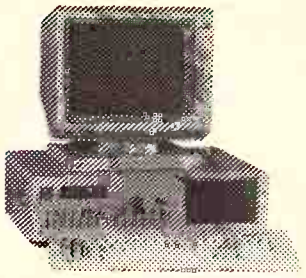

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- 80286 CPU
- 8 Slots
- 20 M/Byte Hard Disk
- Keyboard
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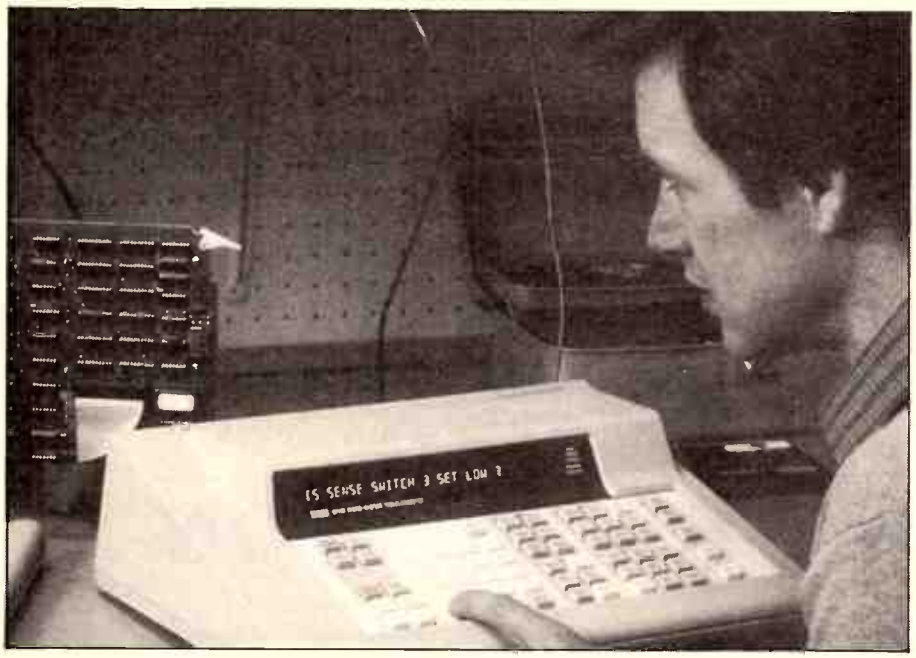
REVIEW

FLUKE 9010A TROUBLESHOOTER

A look inside the Fluke way out of processor troubles. It's not as confusing as you think.

Jon Fairall



Like any electronics magazine, ETI gets lots of invitations to look at bits and pieces of equipment; and we respond by reviewing anything that might potentially be of interest to our readers, from high level oscilloscopes down to tiny pocket calculators. One thing that we, and most other magazines, have steered clear of, is digital troubleshooting equipment.

The reasons are many, not the least being a nagging suspicion that it's all too esoteric and complex to be worth the trouble. Unfortunately, processor-based equipment isn't going away. In fact, the areas where the analogue artisan can now feel comfortably unthreatened seem to be shrinking daily. Even in our tiny lab (two engineers, no R&D grant, one soldering iron and "that's my multimeter sport"), the influence of digital techniques perniciously intrudes. The trouble is, when digital circuits go wrong or won't work, how do you fix them? Unlike analogue equipment, they're not amenable to inspection by an oscilloscope. A multimeter can sort out some of the more obvious construction errors, but as soon as anything a mite complicated starts to occur, it's useless.

So, with these thoughts in our minds, we girded up our metaphorical loins and approached the Fluke 9010A microsystem troubleshooter. Elmeasco, which sells it in Australia, very kindly provided us with its standard, home-brew training manual which turns out to be surprisingly good. What's more, the operation of the 9010 seems intuitively easy. I suspect, however, that what makes it easy is understanding the problem it's designed to solve. Once you understand that, the rest follows.

Fortunately enough, problems in digital circuits, or at least the majority of them, are relatively easy to categorize. One type of problem exists where a line is tied high, low or shorted to some other line. This will typically be the case where the line you test is tied to a specific component that has failed. A second type of problem is one where the relationship between various lines on the board is disturbed. This will typically be the case where you don't have direct access to the component that has failed. A third type of problem is where the timing of the circuit is haywire. Generally this is caused by failure either of the system clock or the circuitry used to process it.

The first thing to do is get acquainted with the physical layout of the beast. The troubleshooter comes in a designer-grey case with a distinctly non-typewriter keyboard at the front, a single line display panel and five LED status lights up the side. There are various input/output ports on the back panel and under the front of the machine. One of these front ports takes the cable to the probe. The probe is much the same shape and size as a standard CRO probe, except that it is equipped with two lights, one red and one green. The red light denotes a high, the green a low, and both together indicate that the node under test is switching between the two. Both lights flash to indicate a high impedance node.

The other cable from the front of the 9010 goes to the pod. The pod is a small calculator-sized box in matching grey, with a ribbon cable coming out of it that plugs into the processor socket on the device under test. This gives some hint of the tremendous flexibility of the instrument, because the pod is tailored specifically for the microprocessor it is designed to test. It contains all the software and hardware to match the 9010 to the processor. This means not only that a large range of current processors can be supported, but also that future developments can be catered for without redesigning the whole box and dice. Current pods support Z80s, 6500 family, 8000 family, the 68000 and so on. ▶

According to Elmeasco, the first 32-bit pods will be available next year, indicating that the unit will be valuable in troubleshooting state-of-the-art boards for at least the rest of this decade.

So what does it do? Elmeasco provided me with something called a TK80, an annonymous board of uncertain function to use as a target for the 9010. The processor is an 8080, so the first step is to plug the relevant pod into the 9010 and into the processor socket, and turn everything on. The Fluke will test itself and the pod to ensure that any faults discovered really are in the unit under test, not in the test equipment.

Essentially the troubleshooter now looks at the system from the processor site and checks the operation of everything it can see. The first step is to teach it what the unit under test should look like. This can be done by plugging in a known good board and pushing the LEARN button, by giving it the information in a tape drive, by feeding it down an RS232 link or by manual entry. The first alternative is obviously the easiest, although it takes a while. The tape drive is quick and simple.

Once the 9010 knows what to look for, the operator can order a number of tests. The bus test will check that no lines are tied high, low or together (this test can actually be done without the benefit of the LEARN function). The RAM test will write 0 to every memory, toggle it and read back a logic high. It also does a test to ensure that there are no pattern errors in the RAM, ie, errors where the value of one bit affects the value of some other. It does a ROM test by comparing known ROM with the contents of the ROM in the device under test. It also reads and writes to all the I/O lines it can find.

Because the pod is plugged into the processor socket, it is possible to read and write to any location on the board to which the processor has access, including all the memory, the I/O and the control lines. A number of things are possible because of this. For instance, one can run the device under test from any particular memory location in either its RAM or ROM. One can test that faults have been rectified, or download a machine code program into RAM. There are also some special functions like RAMP which will automatically step from 00 to FF in single step increments. The WALK key presents some data to the bus and then steps it to the right. Other functions allow one to increment, decrement, toggle, AND, OR and so on.

It's also possible to program the 9010, for situations where a repetitive test sequence is required. Programming works on much the same basis as that of a calculator. Push the PROGM button, and it will record in sequence all your keystrokes. To get out of the programming mode you push the PROGM button again. To make it more powerful, there is also a facility for conditional branching on the basis of results coming back from the device under test.

The 9010 is an excellent way to find faults in digital boards. A typical system consisting of the 9010A and an 8-bit pod costs from $12,275. A cheaper version, consisting of the 8-bit pod and a 9005 which does without the programming facilities, costs from $9300. Eighteen interface pods are available covering over 50 microprocessors and another three are expected to be released later this year. ●

ADVERTISERS' INDEX

REVIEW

BUYERS' GUIDE TO LAPTOP COMPUTERS

Welcome to our survey of the laptop computer market. It is an interesting survey if only because it reveals a wide variety of specifications and prices. Perhaps this reflects an unstable market; one that is not yet quite sure who the customers are or what they want. All of the devices described herein are small, and the columns for size and weight reflect briefcase sizes and totable weights. The manufacturers have yet to work out exactly who will pay a premium for this, or indeed, if they will.

One thing everyone agrees on is that portability is a must. Virtually all of these units can operate away from the mains; mostly via battery, but some from 12 Vdc. They are thus models of engineering efficiency in terms of power saving circuitry.

The general configuration of these machines is common across the range. They all tend to be limited by the requirements of the keyboard and the screen. A keyboard needs to be a certain size if it is to be useful, so does the screen. Both also need to be protected in a sometimes harsh environment, so the standard pattern is to put the screen on a lid which folds down on top of the keyboard, thus protecting both at the same time. Power requirements, weight and space mean that the screen is almost universally an LCD display. Some manufacturers are playing around with plasma screens, but these yield better legibility at the price of large power requirements and thus short battery life.

There are a wide variety of ways of providing mass storage in laptop computers. One very elegant system favoured on the Time Kookaburra and some others is to provide a RAM disk on board, with an external disk drive. The external drive requires mains power, and is designed to sit on a desk, leaving the portable free of the engineering requirements of a disk drive. Another alternative is to supply an in-built hard disk like Data General has done on the DG1. This gives something like 10 Megabytes of mass storage on board. Almost all of them provide a 3.5 inch or 5.25 inch disk drive system either on board or externally.

Almost all the laptops come with a quite extensive range of enhancements necessary to turn them into sophisticated computer systems. Video output to allow them to drive monitors, sometimes in colour, is quite common. Rather less common are modems. Only two supply them as an internal option, and a few more externally. This seems a little strange given the fact that laptops are designed to be used on the move.

One area where there is a wide discrepancy is in the software that comes bundled with the package. Some come fully featured with wordprocessor, database and spreadsheet in firmware. Others come with nothing; you have to supply all your own.

Brand	Model	PC Compatible
Bondwell	8	y
Chendai	Lap 1	XT
	Lap 2	XT
Data General	DG1 Model 2	y
Epson	PX-4	n
	PX-8	n
Ericsson	Portable PC	y
HRC-Time	Kookaburra	n
Hewlett-Packard	Portable Plus	n
IBM	5140	y
NEC	Multispeed Portable	y
Olivetti	M15	y
Sharp	PC2500	n
Tandy	102	n
	200	n
Toshiba	T1100 Plus	y
	T3100	y
	T2100	y
Zenith	Z-171	y
	Z-181	y

Size (mm)	Weight (kg)	Power	Screen	Screen Size	No. of Lines on Screen	Video Output	Processor
	4	240 Vac; 12 Vdc battery	LCD		25	y	80C88
390 x 310 x 90	7.5	240 Vac; battery	LCD		bit mapped	y	80186
390 x 310 x 90	7.5	240 Vac	LCD		bit mapped	y	80186
370 x 30 x 80	10.5	240 Vac; 12 Vac battery	LCD; EL	750 x 260	bit mapped	y	80C88
297 x 216 x 34	1.6	240 Vac; battery	LCD	132 x 35	8	n	Z80
297 x 216 x 47	2.3	240 Vac; battery	LCD	221 x 32	8	n	Z80
115 x 390 x 310	7.6	240 Vac	plasma		25	n	8088
285 x 325 x 58	4	240 Vac; battery	LCD	230 x 60		y	80186
330 x 254 x 76	4.1	240 Vac; battery	LCD		25	y	80C86
360 x 309 x 67	5.5	240 Vac	LCD	—	25	n	80C88
345 x 75 x 300	5.4	240 Vac; battery	LCD		25	y	8086
280 x 355 x 70	5	240 Vac; battery	LCD		bit mapped	y	80C88
300 x 45 x 210	1.3	240 Vac; 12 Vdc battery	LCD	100 x 32	bit mapped	n	proprietary
38 x 300 x 215	1.36	240 Vac; 12 Vdc battery	LCD	42 x 152	8	n	80C85
55 x 216 x 298	2	240 Vac; 12 Vdc battery	LCD		16	n	80C85
66 x 307 x 305	4.5	240 Vac; battery	LCD	231 x 119	bit mapped	y	80C86
311 x 360 x 80	6.9	240 Vac	plasma	192 x 144	bit mapped	y	80286
311 x 360 x 80	6	240 Vac	plasma	192 x 144	bit mapped	y	8086-2
240 x 330 x 168	6.5	240 Vac; battery	LCD	240 x 105	25	y	80C88
340 x 295 x 80	5.4 (incl batt)	240 Vac; 12 Vdc battery	LCD		25	y	80C88

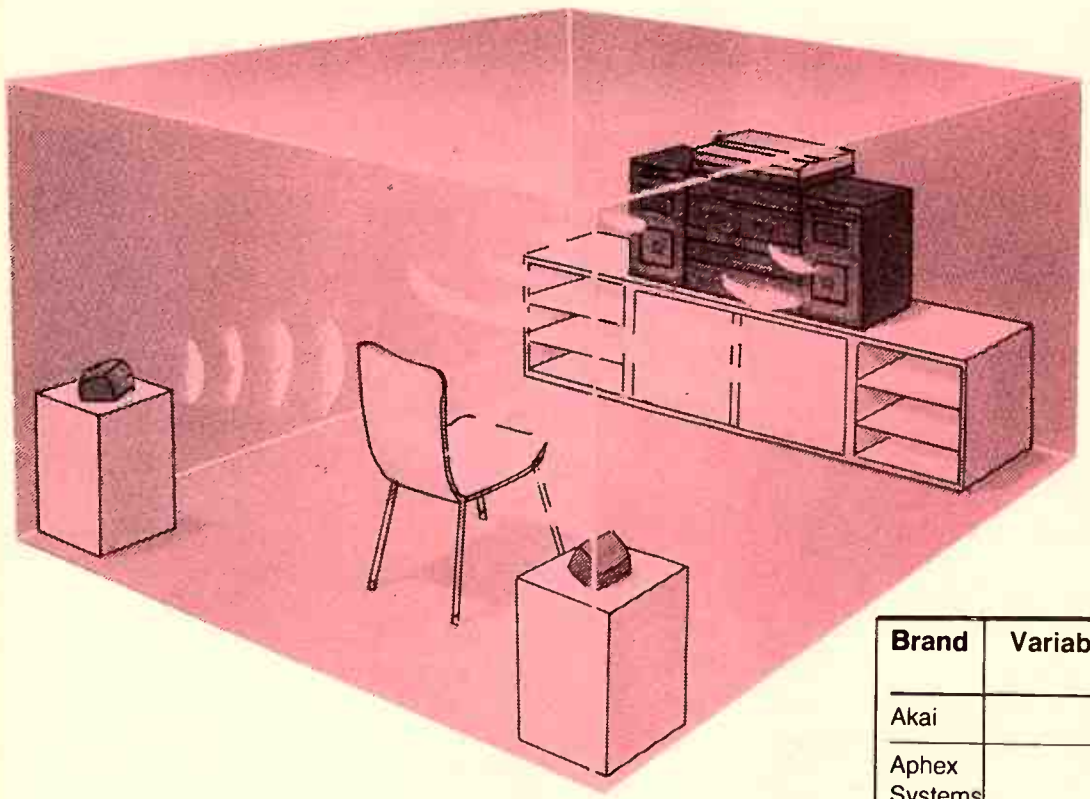
LAPTOP COMPUTERS BUYERS' GUIDE

Brand	Model	Bits	Speed (MHz)	RAM			Mass Storage		Soft
				Standard K	*Total Internal K*	*Total K*	*Internal*	*External*	*Internal*
Bondwell	8	16	4.77	512	512	512	3.5; 5.25	3.5; 5.25	BASIC
Chendai	Lap 1	16	4.92	640	640	640	dual 5.25	—	none
	Lap 2	16	4.92	640	640	640	hard disk	—	none
Data General	DG1 Model 2	16	4	256	640	640	hard disk	5.25	none
Epson	PX-4	8	3.68	64	64	64		3.5; 5.25; RAM disk 128K	BASIC
	PX-8	8	2.45	64	64	64		3.5; 5.25; RAM disk	BASIC
Ericsson	Portable PC	8	4.77	256	512	512	5.25	hard disk; 5.25	none
HRC-Time	Kookaburra	16	6	96	256	256	RAM disk	3.5; 5.25	Telcom; word processor; database; spread sheet
Hewlett-Packard	Portable Plus	16	5.33	512	1M	1M	RAM disk	3.5	PAM
IBM	5140	16	4.77	256	512	640	3.5	none	—
NEC	Multispeed Portable	16	4.77; 9.54	640	640	607	hard disk	5.25	Notepad; Outliner; Telcom
Olivetti	M15	16	4.77	512	512	512	3.5	5.25	none
Sharp	PC2500	8		5	21	21	cassette		BASIC
Tandy	102	8	2.4	24	32	32		3.5	calendar; BASIC; Telcom
	200	8	2.4	24	72	72	nil	3.5	Multi plan; BASIC; Telcom
Toshiba	T1100 Plus	16	4.77	256	640	640	3.5	5.25	none
	T3100	16	4.77; 8	640	2640	2640	hard disk; 3.5	5.25	none
	T2100	16	4.77; 8	256	640	640	3.5	hard disk; 5.25	none
Zenith	Z-171	16	4.77	640	1M	1M	hard disk 5.25	none	calculator; calendar
	Z-181	16	4.77	640	640	640	3.5	none	calendar

ware External	No. of Ports Serial	Parallel	Expansion	Operating System	Internal Extras	External Extras	Price $	Distributor
—	1	1	ASM	PC-DOS	real time clock	p/supply; remote	1699	Pulsar
n/a	1	1	1	MS-DOS	3270 emulation board		3395	Chendai
n/a	1	1	1	MS-DOS	3270 emulation board		4650	Chendai
n/a	1	1	1	MS-DOS	colour adaptor; ASY NC I/O	printer; Tx-Rx; Card expansion chassis; modem	3500-8000	Data General
	2	1	1	CP/M 2.2	clock; barcode; cassette		1524	Epson
Wordstar; Supercalc; dBASE II	2	1	1	CP/M	real time clock; barcode		977	Epson
n/a				MS-DOS	printer; modem	M-mainframe link; 3270 PC emulation	4595	Ericsson
BASIC; Turbo Pascal	2	1	1	MS-DOS	real time clock	RAM pack burn-in service	1755	HRC-Time
	1	—	—	MS-DOS	clock; modem		6796	Hewlett-Packard
n/a	0	0	1	PC-DOS	serial port; parallel port	printer; video	4106	IBM
n/a	1	1	0	MS-DOS			3373	NEC
n/a	1	1	1	MS-DOS	real time clock	5.25 floppy drive	2999	Olivetti
	1			proprietary	printer; plotter		650	Sharp
	1	1	1	proprietary	real time clock	cassette; printer	999	Tandy
	1	1	1	proprietary	real time clock	printer; cassette	1399	Tandy
n/a	1	1	1	MS-DOS	calendar; clock	video	3890	Toshiba
n/a	1	1	1	MS-DOS	calendar; clock		8900	Toshiba
n/a	1	1	0	MS-DOS	real time clock		4750-6900	Toshiba
n/a	1	1	1	MS-DOS	video card; battery	modem	4675	Anitech
n/a	1	1	0	MS-DOS	real time clock; coprocessor	modem	5595	Anitech

REVIEW

BUYER'S GUIDE TO SURROUND SOUND



Brand	Model
Akai	AS-P302
Aphex Systems	AVM8000
Fosgate	3601
NEC	AV-300E
Pioneer	SPX707
Raidek	SD100
Shure	HTS5000
Sony	SDP-505ES
	SH-AV22

Surround sound systems are part of the growing trend towards the integration of domestic audio-video systems. They are designed to decode the extra audio tracks present on video tapes, and direct them to speakers scattered around the TV viewing room. In this way, something of the ambience of the cinema can be recreated in your living room.

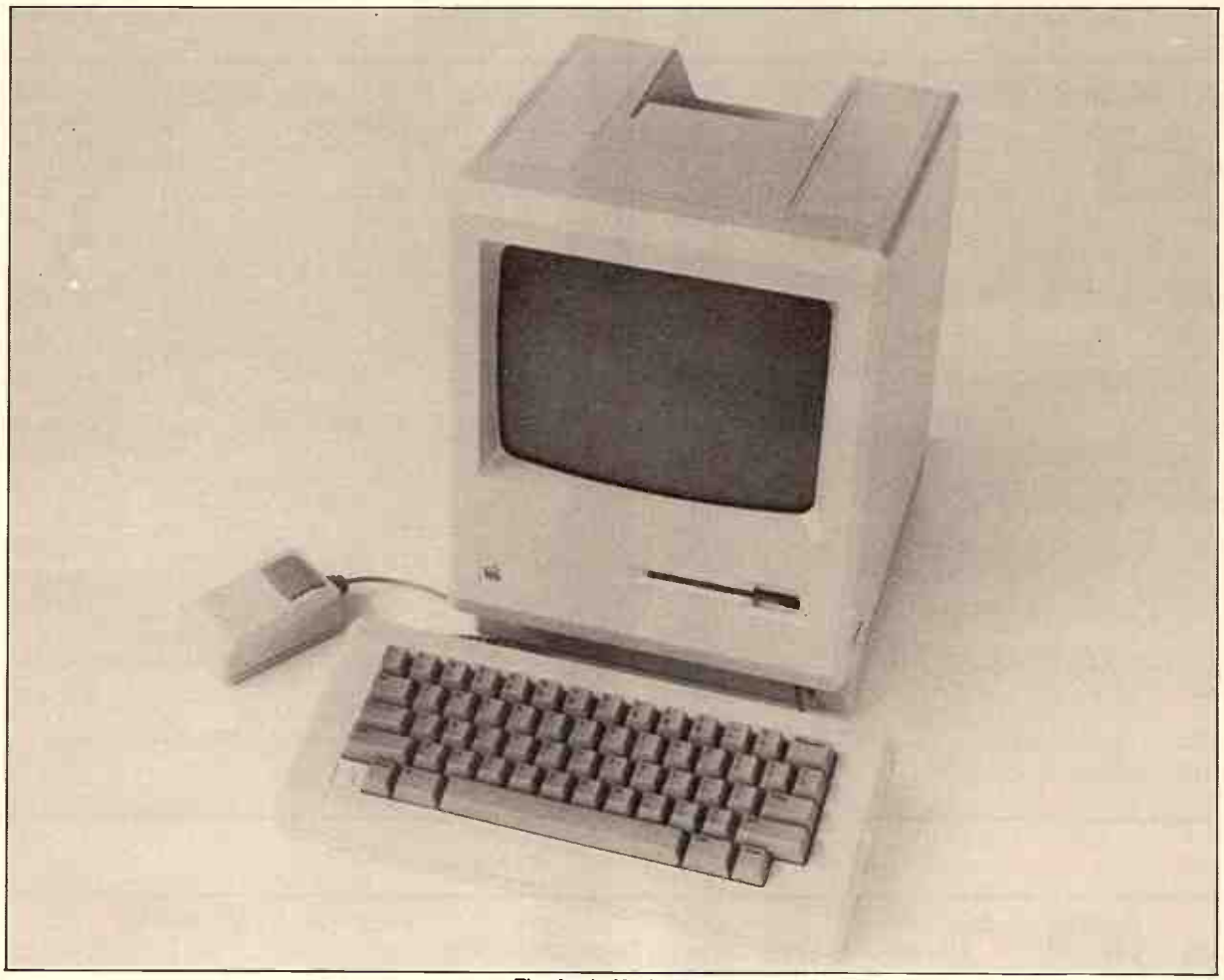
There are several different ways of actually doing the decoding. They can range from using the same protocols as are used in the cinema, through to synthesizing stereo when only a mono track is present on the tape.

Surprisingly, the more expensive units have no amplification on board. The idea here is that each speaker or set of speakers ought to have its own. This is fine in a professional or semi-professional environment, but is not likely to impress a cost-conscious home user. Other units have an on-board amplifier, so that some of the speakers can be driven directly.

Brand	Variable Delay	Audio Processing
Akai	n	—
Aphex Systems	n	cinema mode; dolby MP; SQ8
Fosgate	n	ambience; theatre; panorama; stadium
NEC	y	matrix; dolby; hall
Pioneer	n	theatre; stadium; dynamic expander
Raidek	y	cinema matrix
Shure	adjustable digital 16-36 microseconds	cinema dolby Acra-Vector decoder; acoustic space generator processor
Sony	y	matrix; dolby; hall
	n	BGV mixing; mic mixing

Dimensions (mm)	Weight (kg)	Warranty (mths)	Audio Inputs	Video Inputs	Power per Channel (W)	No. of Speakers	Subwoofer Output	Noise Reduction
440 x 78 x 260	4.9	24	2	4	25	2	n	dolby surround
45 x 230 x 425	3.4	12	2	0	—	8	y	nil
440 x 89 x 229	4.7	12	2	—	44	3	n	dolby surround
110 x 430 x 340	9.5	12	5	4	30 x 4; 60 x 2	4	y	dolby
360 x 75 x 332	5.7	36	2	—	30	4	y	dolby surround
435 x 44 x 254	4.9	12	1	0	25	2	n	nil
60 x 427 x 382	4.5	12	2	1		6	y	dolby; stereo; dolby surround
430 x 85 x 350	7.4	12	2	0	20	4	y	dolby surround
430 x 86 x 236	2.8	24	5	2	—	4	n	nil

Video Processing	Remote Control	Synthetic Stereo	Channel Separation	Degree of Separation (dB)	Price ($)	Distributor
—	y	n	matrix	60	599	
n	y	n	—	60	2500	East Coast Audio
n	y	y	proprietary	40	1995	Southern Cross Audio Video
n	y	y	matrix	—	899	
n	y	y	logic steering	68	899	
n	n	n	logic steering	40	599	Raidek
y	y	y	logic steering	—	2649	Audio Engineers
n/a	n	y	matrix; logic steering	—	1599	
n	n	—	—	—	379	



The Apple Macintosh.

REAL MACHINES

What machines are available on the market? This instalment looks at the relative merits (and demerits) of two standards. It also covers the delicate question of software protection — and software piracy.

Phil Cohen

Now that you know how a small computer works and what it does (we hope), it's time to start looking at some specific examples.

IBM

The machine of the moment is the IBM-PC. It's unfortunate but true that IBM-PCs and machines similar enough to run the same software (called 'IBM-compatibles') have become a de facto standard for the microcomputer industry. 'Unfortunate' because there are a lot of better machines around, especially when it comes to keyboard layout. There will be even more of them in the future but they will all be held back to an extent by having to conform to the IBM 'standard'.

The base model IBM-PC is usually provided with one 5¼" floppy disk drive and around 256K of memory. It is built into a large metal cabinet which has a single motherboard (IBM calls this a 'planer board' to avoid charges of sexism!) with space for a number of plug-in boards to handle printers, extra memory, and so on.

In fact, many people are coming to regard 512K or 640K of memory as standard for any PC because there is so much software around these days requiring that much memory. To expand a PC to 640K of memory you usually have to plug just one extra board into one of the slots on the motherboard.

Most of the memory boards on the market have more than just memory on them too. Typically they will have a serial port and a real-time clock as well.

A real-time clock is a very useful addi-

tion for business systems. Basically it's an electronic clock run by a battery, which keeps track of the time even when the computer is turned off.

The 'PC keyboard is notorious for being one of the worst features of the IBM machine. In particular, it lacks basic things like an indicator to show that the shift lock is on.

Other failings include such fundamental things as price (although IBM has started bringing it down of late). However, for all its faults it's a good solid machine and the 'PC (and IBM) will be around for some time.

Apples

Of course, the home computer market was started by companies like Apple; IBM came in later and more heavily. There are still plenty of the old Apple II machines around, particularly in schools and technical colleges.

The original Apple was ridiculously puny by today's standards with only a few K of memory, and it's still a problem to use more than about 64K on a modern Apple. Like the 'PC, the Apple is built around a series of slots on its motherboard, which can be used to expand the machine in almost any way you like.

It was those slots that made the Apple such a success. The company made no secret of the ways in which people could build cards to plug into the machine, and there are even cards around that replace the entire Apple processor with a new one — a Z80. With that sort of flexibility it's not surprising that the Apple was popular with researchers and the like.

There is still software being produced for the Apple, and I suspect there is still more software available for the old machine than there is for the IBM, although for how long that will remain true I wouldn't like to say.

Talking of slots, it's interesting to note that Apple's latest machine the Macintosh (named, with typical ignorance of marketing techniques, after a US strain of Apple) has no slots at all. The company decided to make the 'Mac' a 'closed architecture' microcomputer — much to the surprise of everyone who knew why the original Apple had been such a goer. I notice that Apple's latest move is to try to add slots to the Mac.

> ***The 'PC keyboard is notorious for being one of the worst features of the IBM machine. In particular, it lacks basic things like an indicator to show that the shift lock is on.***

A major difference between the Apple and the 'PC is in the processor. The Apple is built around an 8-bit processor called the 6502, while the PC is built around the 16-bit 8086 range. A few years ago this was made out to be a big selling point for the 'PC, but the public is not so easily fooled. In fact, things like disk access speed are much more important than processor size when it comes to determining just how fast a given machine will go.

Software protection

One subject sure to cause an argument at any place where software buyers and sellers meet is protection.

When the mass-marketing of software first started a few years ago, it was sold either on cassette tape or disk, and if you wanted to copy a friend's software all you had to do was hand over a blank tape or disk and get a photocopy of the manual.

Quite a trade in copied software went on for a few years, with people swapping interesting packages with each other like bubble gum cards. Then, inevitably, the people who were selling the software started thinking about how much more money they would make if it was impossible to copy software and everyone had to buy the package.

So software protection was born. There are a number of different forms, but the most common rely on the complexities of the disk controller inside the computer. A typical 'protection scheme' is to have a vital part of the program hidden on the disk in such a way as to make it unreadable.

A common way to do this is to rearrange the sectors on part of the disk so that they do not conform to the pattern of the rest of the disk. When the software is started up, it changes the settings of the disk controller in the computer and reads the hidden part of the software into memory. But if you try to copy the whole disk using a standard copy program, it will not 'know' what the special format of the hidden part of the disk is, and will, therefore, not be able to copy it.

Simple. But there are two major problems. Firstly, people who spend hundreds of dollars on a piece of software want to ▶

An early IBM-PC keyboard.

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be able to copy it just so they can have a 'backup' in case of coffee spillage, etc. Secondly, a number of clever people have developed special copy programs that can read the hidden software no matter what disk format it used. There are even special hardware arrangements which allow you to take a 'snapshot' of the hidden software once it has been loaded into memory, and get around the problem that way.

An alternative to the hidden software arrangement is the 'dongle' (one of my favourite words!). A dongle is a small piece of hardware, usually built into a plug, which is inserted into one of the sockets on the machine when you want to use the software in question. The first thing the software does when you start it up is look to see if the dongle is there. If it is not, the software refuses to run. This allows copying of the software for backups, but not use of the software by anyone who does not have the dongle.

Of course, you could copy the dongle, but that is generally considered to be too much trouble.

The arguments for and against software protection are many and various, and a debate has been firing on the subject ever since home computer software has been sold.

Software 'piracy' refers to when someone sets themselves up with a special copying program, and starts *selling* copies of a software package he or she has copied. This is, of course, immoral, not to mention illegal. When I lived in Hong Kong you could buy a copy of *any* piece of software to run on the Apple for just over the price of a blank disk — and you could buy it a matter of days after it was released in the US!

Glossary

16-bit: Being able to handle information in batches of 16 binary digits at a time.

6502: The 8-bit processor used in the Apple range of computers.

8-bit: See 16-bit.

8086: The 16-bit processor used in the IBM-PC.

Backup: Taking a copy of a disk in case of damage to the original.

Closed architecture: A lack of slots.

Disk access speed: The speed at which a computer can find a given piece of information on a disk.

Dongle: A piece of hardware that software will look for before it decides whether to operate or not. The dongle prevents use of the software on more than one machine at a time, no matter how often the software might be copied.

Format: The way in which sectors are arranged on a disk.

IBM: International Business Machines — also known as 'Big Blue' in the computer industry because of the colour of its computers' cabinets.

IBM-PC: IBM's late and very significant entry into the personal computer market. An office, rather than a home computer.

IBM-compatible: Used to describe a computer that can run most of the software that an IBM-PC can run.

Macintosh: A seminal machine developed by Apple.

Piracy: Selling copies of software.

Planer board: What IBM calls a motherboard.

Protection scheme: A method of making the copying of software for profit difficult.

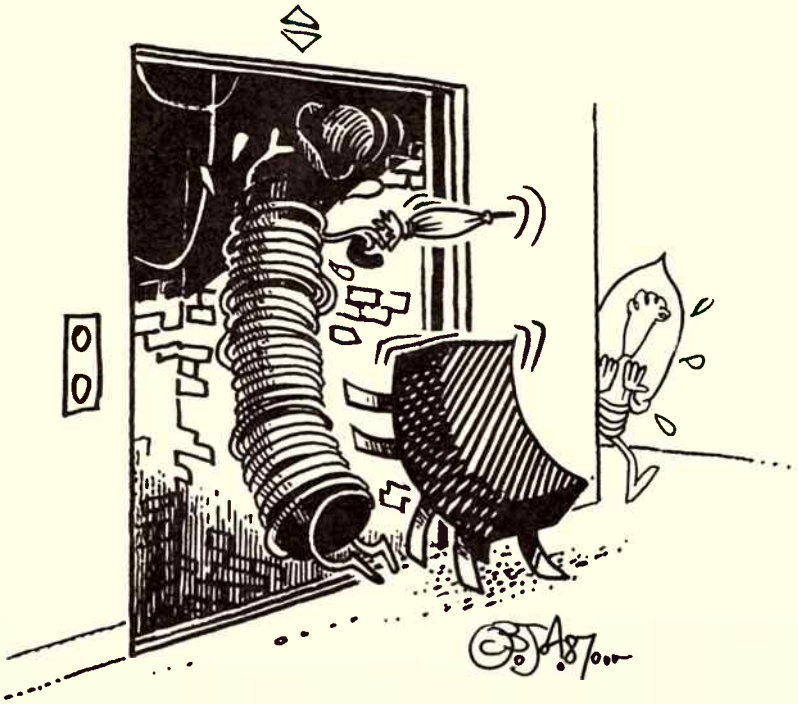
Real-time clock: A clock built into a computer, so that the time and date can be used in programs.

Slot: A long socket on a motherboard for extra boards to be plugged into.

Snapshot: A method of recording the contents of memory, normally for the purpose of avoiding protection schemes.

Z80: An 8-bit processor. ●

A TURN FOR THE GYRATOR



One of the long lost elements of low frequency design is the inductor. Exiled due to large size and high cost it was one of the first casualties of the integration revolution. But now the gyrator provides a path for its reinstatement.

Glen Thurecht

In modern day electronic design with low frequencies, the inductor is rarely used. This is due to fundamental problems in constructing the devices for operation at these frequencies. Such inductances would have to be of high values so as to give reasonable values of reactance. This, in turn, means a large number of turns on a good quality former and, therefore, the physical size is large, the cost is high, and non-ideal performance is obtained due to the series resistance in the wire. As a result of these limitations circuit designers make do with resistors, capacitors and active devices such as transistors and operational amplifiers.

This switch to resistor/capacitor (RC) type design was pushed along by the fact that inductors could not be incorporated into integrated circuits. Filter design was one of the first casualties of the change in philosophy. Inductor/resistor/capacitor (LRC) circuits for producing filters which had been the norm in the day of the vacuum tube were quickly replaced with active RC filters. This type of design could be completely integrated or generated cheaply and easily around a building block such as an op-amp. To achieve the high order filters (ie, sharp transfer characteristics from pass band to stop band) that had previously been designed with inductors, a number of RC sections could be cascaded. However, in doing this the tolerances needed for the capacitors and resistors increase greatly. Indeed, it is not uncommon for some high order RC filters to have 0.1% component tolerances specified.

> ***It can be used just as any passive inductor could be. In fact, it is a better device than an inductor constructed in a conventional way because the series R component is extremely low.***

On the other hand, this is not a problem in the design of high order LRC circuits. Here the tolerances are about an order of magnitude lower. If 0.1% components are specified in an RC design, 1% components can generally be used in the equivalent LRC design.

The low sensitivities of the LRC designs was one of the driving forces that led to

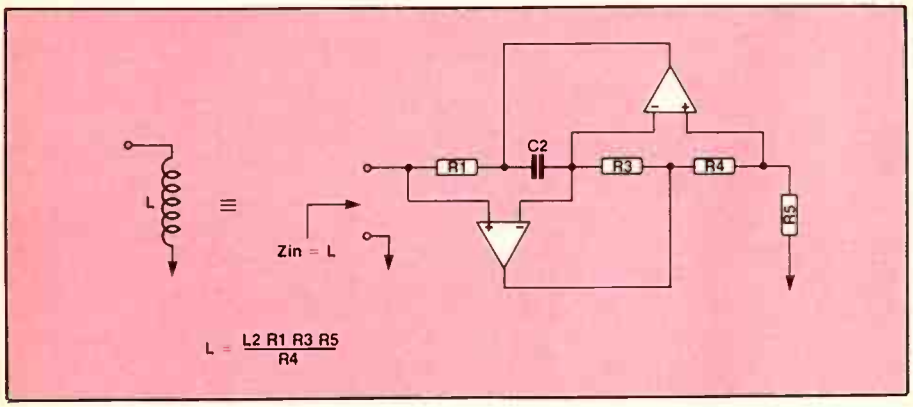


Figure 1. This circuit shows one of the many possible configurations of a gyrator. The circuit forms the equivalent of semi-floating inductor.

the development of the gyrator or simulated inductor in the 1950s, '60s, and '70s. This is an active device that behaves as an inductor at its input terminals. By placing a voltage source on the input terminals, A-B, and calculating the input current it can be shown that the gyrator behaves exactly as an inductor would. The input impedance can then be calculated from the equation:

$$Z_{in} = \frac{V_{in}}{I_{in}}$$

At low frequencies its impedance is small and at high frequencies its impedance is large.

The circuit drawn in Figure 1 shows one of the many realizations of a gyrator and its equivalent. It can be used just as any passive inductor could be. In fact, it is a better device than an inductor constructed in a conventional way because the series R component is extremely low. Since an ideal inductor has no losses, it is this series R component that is responsible for all power dissipation and hence the maximum Q (quality factor) that can be obtained. Qs of 100 or more and inductances of Henries or tens of Henries are possible at low frequencies.

Note that this circuit produces an inductor that has one side grounded. This is termed a 'semi-floating' inductor and is extremely useful for producing parallel resonant circuits. Figure 2 shows a parallel resonant circuit using a gyrator and its frequency response. This circuit shows the high Qs that can be obtained at these low frequencies.

Gyrators can be constructed from many different circuit configurations. The two op-amp gyrator is the most common form used in high quality simulation but single op-amp gyrators may also be made. The big disadvantage of the single op-amp gyrator is that close tolerance components are needed to achieve Qs of even small values. Also the circuit parameters have temperature coefficients that are much greater than in a two op-amp gyrator. Figure 3 shows some single op-amp gyrators. The circuit of Figure 3(a) requires $R_1 = R_2$ for high Q but also $R_1 > R_2$ for stability.

Two op-amp gyrators, by contrast, have extremely high Qs, need low component tolerances, and have very good temperature stability. With the cost of operational amplifiers being so small these days the added expense of a two op-amp gyrator is almost always traded for the higher performance and lower component tolerances.

The limitations on the maximum Q that can be obtained by these circuits are the result of the following factors:

1. amplifier gain that must be high;
2. amplifier input impedance that must be high; and,
3. stray capacitance that can either increase or decrease the Q depending on where the stray capacitance is located.

As has been mentioned, this circuit produces a semi-floating inductance. These elements are found in band pass and high pass circuits. The low pass circuit, however, requires an inductor that does not have one terminal grounded but is fully floating as is illustrated in Figure 4(a). One way to produce a floating inductor is to place two semi-floating gyrators back-to-back which provides an input terminal and an output terminal. This method has been used in the past but is not popular since both gyrators have to be highly matched. If there is any imbalance between the two gyrators this appears as a parasitic inductance to ground. Thus a dilemma: in order to have low tolerances in circuit components we attempt to implement an LRC design using gyrators but ▶

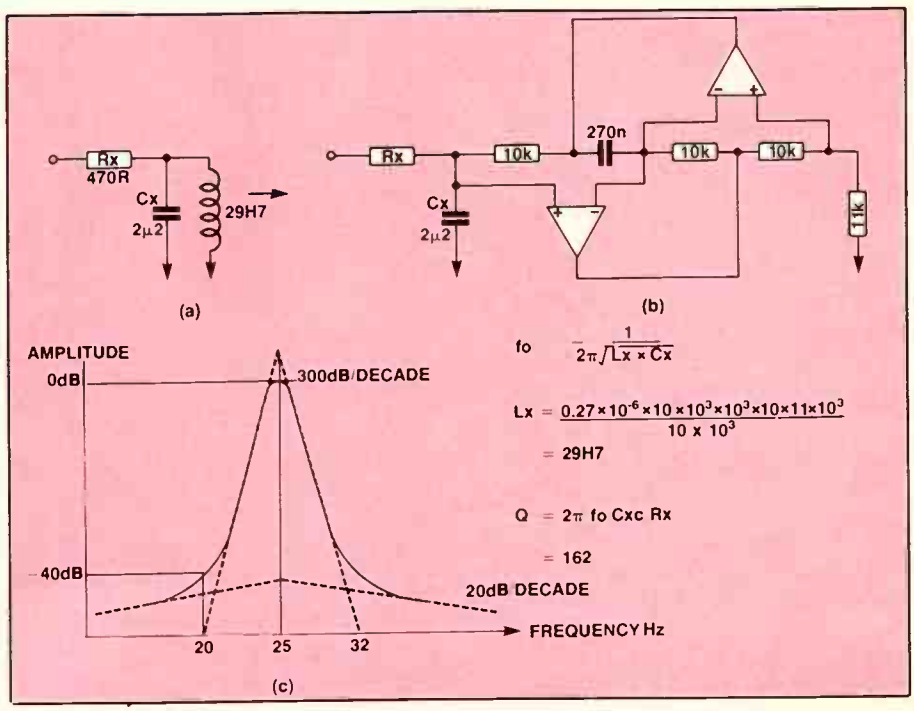


Figure 2. (a) LRC bandpass circuit; (b) equivalent circuit with inductor replaced by gyrator; (c) frequency response of the filter showing how high selectivity can be achieved with a high Q resonant circuit.

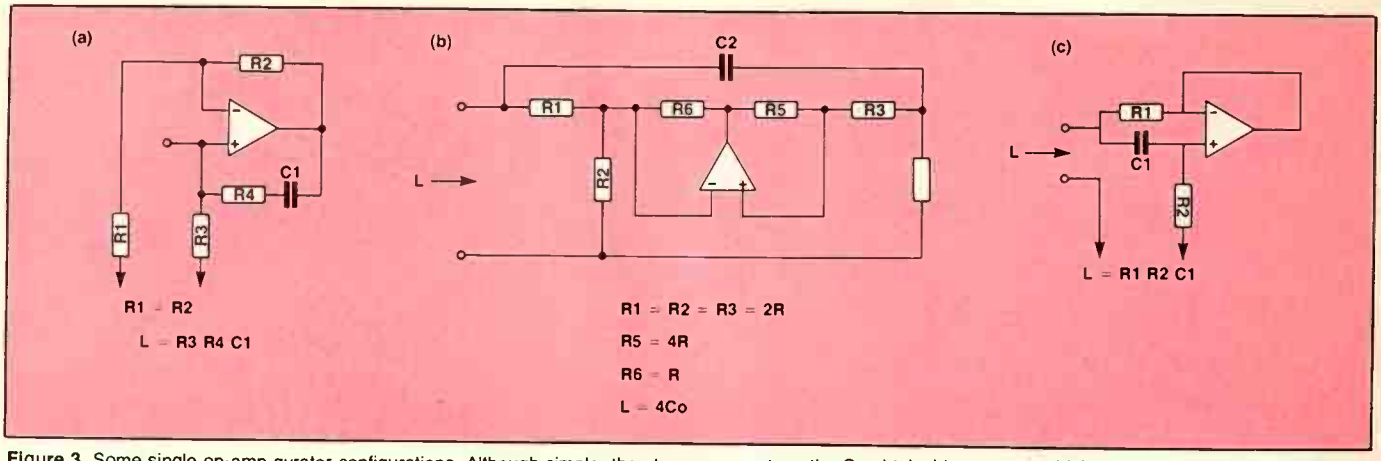


Figure 3. Some single op-amp gyrator configurations. Although simpler than two-amp gyrators, the Qs obtainable are not as high.

since we need a floating inductor we must use high tolerance components to obtain the balanced gyrators.

A solution to this problem was found by L. T. Bruton in 1969. He used a method of transforming an LRC low pass circuit into a form which could be realized using semi-floating gyrators. This transformation is simple in application and is shown in Figure 4. All that is required is to take the original LRC circuit as shown in Figure 4(a) and transform the components as in Table 1. Table 1 shows that resistors are replaced by capacitors, inductors are replaced by resistors and capacitors are replaced by a new circuit element called a 'frequency-dependent negative resistance' (FDNR). These FDNRs can then be synthesized by a gyrator circuit. Figure 4(b) shows the transformation of the original LRC circuit and 4(c) is the implementation using gyrators. Note that in order to simulate an FDNR the same configuration as the gyrator inductor is used except one resistor is replaced with a capacitor.

As a mathematical divergence, the transformation used by Bruton is a magnitude scaling of 1/S. The transformation is valid since any circuit can be magnitude-scaled without changing the transfer function T(s).

Now that we have developed the gyrator inductor and the gyrator FDNR, any LRC-type circuit can be implemented with ease. Many books have been written cataloguing the LRC values required for particular responses. These values can be quickly transformed into a circuit using gyrators instead of inductors thus reducing much of the design time.

When high quality, high order filters are required this design technique fills a gap that other methods cannot cope with. At frequencies up to about 20 kHz, digital filters can provide extremely high cut-off rates, good temperature co-efficient and require no high tolerance components. At frequencies around 100 kHz, the high order LRC circuit can be designed using inductors made in the conventional way. In the 20 kHz to 100 kHz range gyrator-type LCR circuits can provide high quality filtering, good temperature stability and can be implemented with standard op-amps or be completely integrated. For frequencies of 20 kHz or below, digital filters may be used but the cost of anti-aliasing filters, analogue-to-digital converters and a dedicated microprocessor system may be too high for some applications. Hence, the LRC-gyrator approach may be attractive.

The applications of gyrators do not stop at filtering. Many other circuits can be implemented with gyrators. Oscillators, modulators, mixers, and even transformers can be developed.

It is surprising that this design technique has not been more widely used. The practical construction is reliable and easily achieved. It provides a viable alternative to the high tolerance RC active filter networks presently popular. With all its advantages the gyrator may yet help the inductor find its way back into low frequency design. ●

ELEMENT	1/S TRANSFORMED ELEMENT
R	C = 1/R
L	R = L
C	D = C

Table 1. Summary of the Bruton 1/S transformation used for eliminating 'floating' inductors.

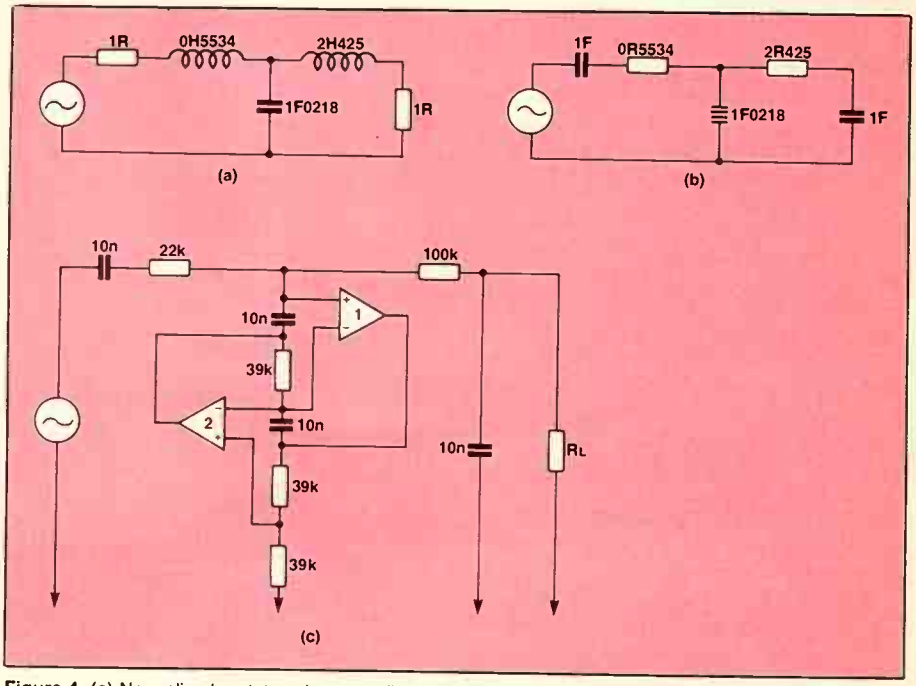


Figure 4. (a) Normalized prototype low pass filter; pass band within 3 dB from 0 to 400 Hz and 20 dB down at 1200 Hz; (b) circuit after transformation; (c) complete circuit using a gyrator as an FDNR; note the R_L must be resistive to provide bias current for op-amp 1's positive input.

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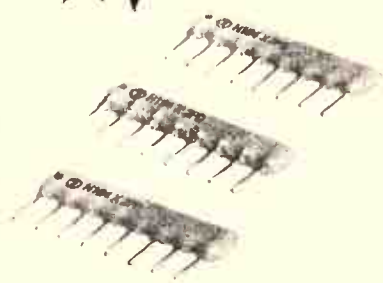

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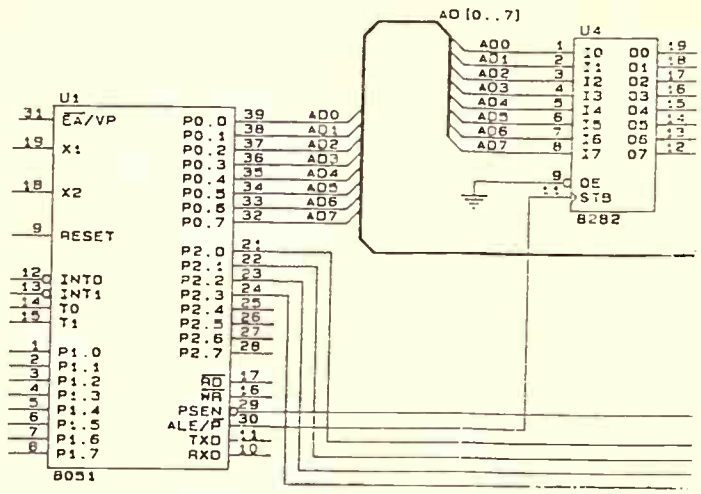

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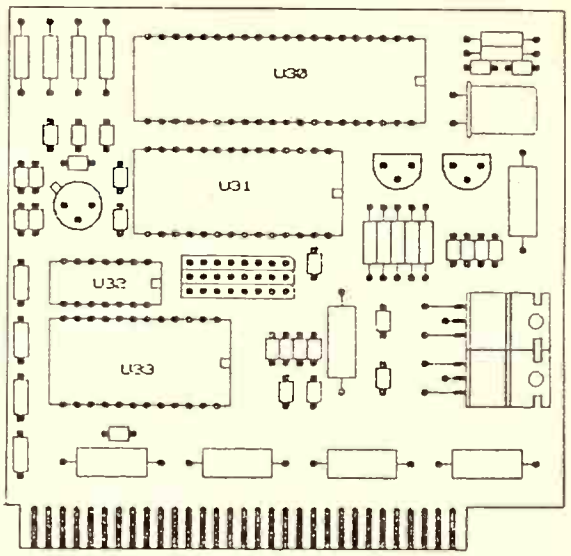

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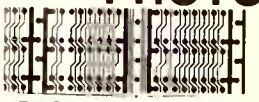

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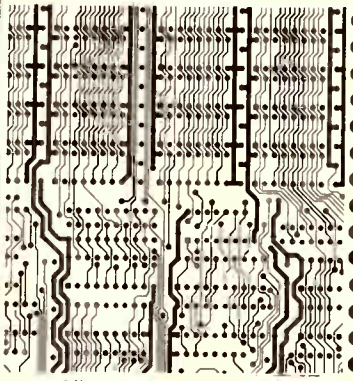

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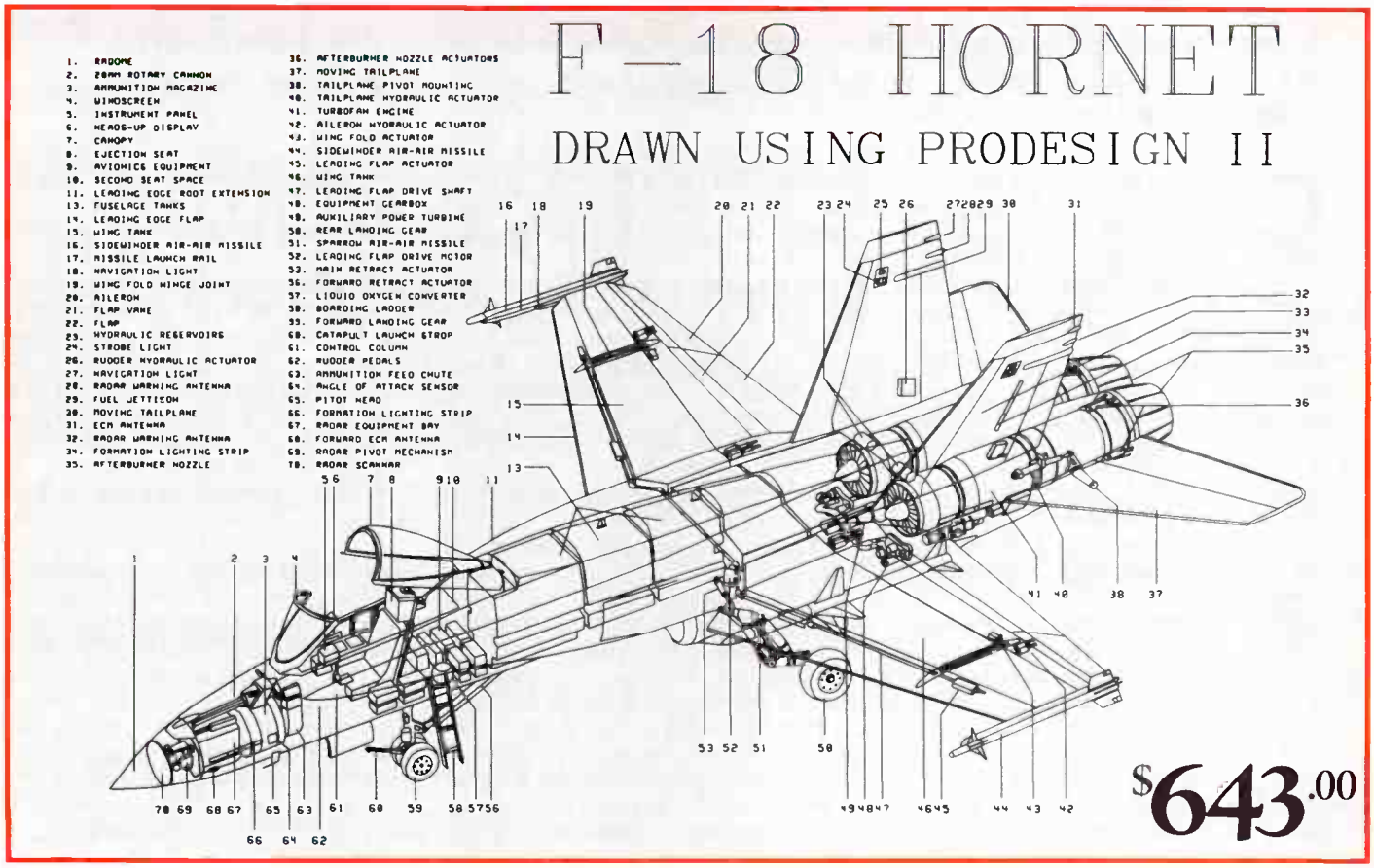

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FACTS AND FANCY IN CIM

Computer integrated manufacturing, once the impossible dream, is now being realized. It's a slow implementation that uses stacks of computer power and is falling foul of the economics of standardization.

Consider the scene; it's an old movie from the 1950s. The factory of the future. It's all white, spotlessly clean. If only humans were present they could eat their food off the floor. Robot conveyors move bits and pieces from machine to machine, constructing goods for a society of hedonists to consume at their leisure.

The modern realization of that dream is computer integrated manufacturing (CIM). Essentially, the idea is that a person should be able to tell a computer what to make, push a button and watch the factory make it. Out the back door will come the finished product, totally untouched by human hands.

Today is perilously close to tomorrow, and we are still a long way from the dream of hedonism and an automatic factory. Factories are as noisy and dirty as they've always been. Computerization seems to have made scarcely a dent, except, perhaps in the car industry. The electronics industry, which one would expect to be leading industries in technology, shows little signs of embracing CIM. To be sure, modern electronic components are usually made in relatively clean environments, and there is little heavy machinery to make a noise, but they still feature row after row of people in a drudging way stuffing circuit boards. So what's going on? Why is CIM taking so long to bear fruit?

Trends

Technically, there is nothing terribly difficult in the idea of a fully automated factory process. Designers know how it should be done; doing it, however, is quite another question.

Consider the design cycle. An idea must be defined and refined into a product. It must be prototyped and tested. Somehow or other, all the information necessary to construct the product must be assembled and the product rolled off the production line. Finally, the product must be tested to see if it performs like the prototype, and even more importantly, like the real thing.

Computers can play a part in all these steps. There is no substitute for a good idea of course, but computers can help in qualifying and quantifying all sorts of aspects of a design. There have been two parallel trends at work over the past few years. One has been the growth in the market for simple computer aided drafting packages. In a technical sense, they offer nothing that has not been around for years. The achievement is that whereas once, not so long ago, a large mainframe was required to run them, now the same functions can be achieved on a desktop. The other trend has been the introduction of other types of packages designed to make life easier for the engineer by taking the drudgery out of many of the jobs he has to do.

The key to this, of course, has been industry standardization on the IBM-PC and its clones. With a de facto standard, software designers have been able to concentrate on optimizing their design for a single piece of hardware. The results, especially in CAD have been impressive. It is now possible to get packages like Protel or smARTWORK for around $1000 that will allow an operator to draw up a circuit board, call components from a library, and even do simple design rule checking.

At the same time, the technical capability of many of these systems has been increasing rapidly. Automatic placement and routing is now available on many systems, for a price, sometimes even on the PC. These systems will take a schematic, determine the optimum placement of the components, ie, the placement that minimizes the amount of board real estate, and then route tracks to their appropriate destinations. Current state-of-the-art is more or less successful in achieving these aims, with Racal's RedCAD system probably the best known. How well the systems work depends on the complexity of the board. It will place 80 per cent to 90 per cent of tracks without manual intervention on a reasonably complex board.

More sophisticated packages will supply output to simulators for checking. Simulation, the ability to determine the behaviour of the circuit before it has been built, is potentially one of the most valuable tools developed over the last few years. Simulation becomes absolutely essential with very complex circuits, especially when the circuit is to be integrated. If the circuit is very complex, the probability that it will work first time is virtually nil. On the other hand, the cost of prototyping might well be prohibitive. As a result, the ability to do the prototyping on the computer, so to speak, is invaluable.

As things stand, simulation still has a way to go before it can drop down to the level where it is generally available. The Mentor Graphics system is a typical low cost system with a professional simulation package on board. It can be purchased with programs for gate array or pc board drawing, the drawing of schematics, and documentation. For this it requires an Apollo workstation with bulk memory and hard disk. It sells for between $55,000 and $80,000 depending on the exact hardware configuration.

However, a reasonably complex board will easily defeat this type of simulation package. The raw processing power required can't be minimized, at least at this point in time, even given the cleverness of software engineers. A company like AWA, for instance, which routinely has the need to simulate very complex circuits, has a set of Apollo workstations using Mentor Graphics software tied into a VAX 785. According to the engineering manager at AWA, Clive Potter, even with the VAX doing 1.5 million calculations a second it can still take up to four hours to run a simulation. Price: astronomical.

Even then, the capability of modern sytems depends very much on whether the circuit is analogue or digital. Simulation for digital devices is far easier than analogue. A digital gate can be described in a few parameters; an analogue component might well require hundreds of cross-referenced parameters to make it meaningful. This requirement alone explains why it is possible to make digital circuits more complex than analogue ones. You can build an analogue circuit, but you can't simulate it.

The other major function of current CAD systems is documentation: the ability to go through a schematic and generate a list of all the parts and then interface to other programs from which suppliers, costs, production schedules and so on can ▶

The Mentor Graphics system up and running.

be generated. Very simply, the CAD system can save many hundreds of man-hours in preparing for a production run, or even calculating whether its viable or not.

Manufacturing

Further downstream from the computer, and the concept of CIM starts to come apart at the seams. To make a working electronic circuit, artwork must be created to etch the copper tracks onto the board, holes must be drilled, parts inserted, and the whole placed in a box. If the device is an integrated circuit, an analagous process must take place. The artwork must be created on glass, and then reduced in size until its smallest features are only as big as the process will allow. Then the silicon is covered in photoresist, exposed to light and etched. So a pattern can be created in a layer of material on top of the silicon. The process can be repeated many times to create extremely dense chips.

Intelligent machines exist to do all these jobs without human intervention. Drilling machines, component insertion equipment and even board etching machines, are readily available requiring only the name of the board to complete their function. Indeed, many machines would be impossibly difficult to build or operate without the processor. IC insertion machines for instance, memorize the position and orientation of every IC on a complex board, and can then reorient themselves as many times as required to accurately stuff the board with components.

Problems arise when one tries to connect these various machines together. As things stand, it's impossible for manufacturers to connect the machine to the CAD system directly, because they have no mutually understandable language. It should not be a difficult thing to do, since the equipment is already based on microprocessor control. In circuit board factories, a partial solution is found in numerical control. Output from a CAD system is taken to the factory and translated onto a tape or floppy disk system as a program that can be run whenever a particular board is to be made. There are a few CAD packages with customized interfaces. For instance, PCad runs something called PCdrill, which can drive numerically controlled drills given the appropriate interface. The facility remains the exception rather than the rule, however.

The reason for this state of affairs is grounded in the good business sense of the vendors. Making your machine compatible with your neighbour's is simply inviting your neighbour in to steal your business. Historically, the computer industry has thrived on lack of standardization. It has only been when consumers have demanded it that the standards have appeared.

Until recently, consumers were not demanding it. The problem too has been a psychological one. It's been difficult enough for a beleaguered factory manager to keep up with all the smart machines without wondering how it could be done better. Recently, however, factory managers all over the world have been realizing the savings that could be made by linking all their bits and pieces together into one whole.

> ***Making your machine compatible with your neighbour's is simply inviting your neighbour to steal your business. Historically, the computer industry has thrived on lack of standardization.***

EDIF

Over the last two years there has been growing discussion about ways of making this whole possible. As a result, a number of standards have been discussed. For instance, IGES targets pc board design as an extension of its major thrust, which is for mechanical description. VHDL is being promoted in the US by the military, and addresses both integrated circuit and system design to the exclusion of functional or logic description. It, in fact, includes no mechanical description at all. A third standard is also being touted around, called x3x3, but it appears to be rather specialized for graphic drivers.

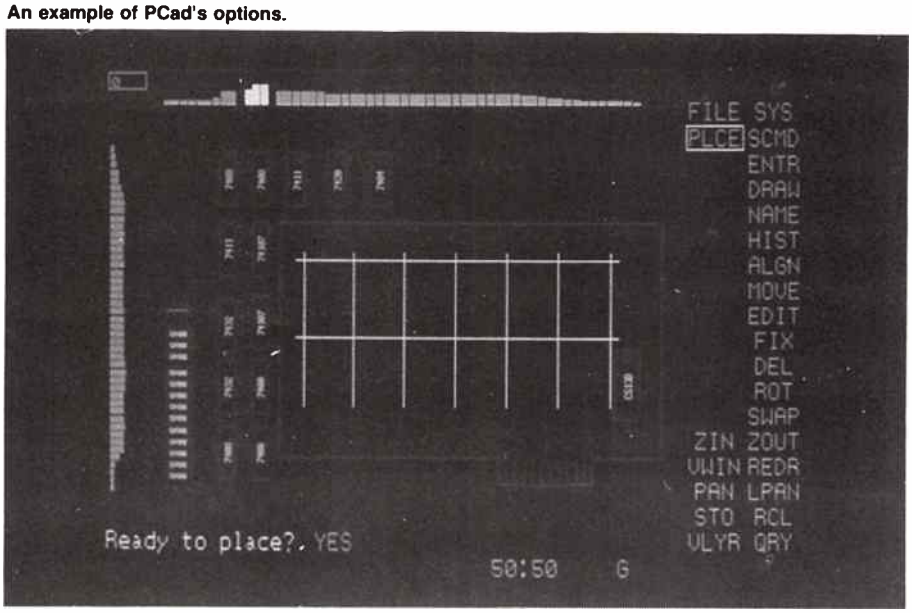
The first real ray of hope for the consumer came in late 1985 with the formulation of the electronic design interchange format (EDIF). EDIF is a public domain format for the interchange of all forms of electronic design data between different systems. It is the first standard that makes some pretence at being broad enough to cover all aspects of design and manufacture.

According to US surveys, acceptance of EDIF is assured even within the equipment manufacturing industry. Within a year of the release of version one, surveys by the US magazine *Electronic Times* found 65 per cent of respondents were planning to use it, 35 per cent were developing interfaces for it and 7 per cent had already done so.

However, EDIF is already proving something of a movable feast. Version 1.1.0, released in late 1985, has already been superceded by Version 1.2.0, and further changes are in the offing. Cynics remember RS232. There are good reasons for the updates however. Version 1.1.0 had a great deal of difficulty with schematics. In fact, it could get confused between the names of ports and signals. Version 1.2.0 removes some of these difficulties.

No matter how much of a standard EDIF is, or how many versions it finally comes to, its existence might mean the real beginning of factory automation, bringing with a new round of social problems and opportunities. ●

An example of PCad's options.



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History

Recently, someone phoned our office wanting detailed advice on a project of monumental antiquity, so the Hack was sent to look up a back copy of ETI. We have a dungeon here, where very old copies of magazines are kept. It's not below ground, but on top of the building, right next to the lift shaft. It is nevertheless, a place of shadows and spiders and darkness, a place where light penetrates only reluctantly through a window last cleaned for the abdication of Edward VIII. Massive cobwebs entangle the odd solitary fly who seeks to bespoil a back copy of this humble mag, standing in its box, along with all the other mags produced through history by this company.

The Hack sat down with the June 1979 copy of ETI and realized he was holding something precious . . . the first copy of the Dregs page.

Typically, the human I/O system was involved. The Dregs Hack of the time had an anal complex which even the most vigorous psychotherapy has failed to alleviate. So there is a picture of a man in a gas mask in a submarine and some inference that perhaps, well, things could smell a little less if he wasn't quite so fond of curried eggs.

There was also a reflection on a certain category of reader: How's this for a letter to the editor: "Having read your stereo amplifier project, I find that I could not possibly afford the parts necessary to build it. Could you therefore send me the prototype. I would be pleased to refund any postage necessary . . ."

The Hack considered this bit of information for a while. Was there some insight here? He pondered. He strolled back to the office and answered the phone. On the other end, a bloke in Perth waited, breath bated for a pearl of wisdom from the ETI technical enquiry line. The call had already cost him $47.50. "Look, mate, I don't know why it doesn't work, but we've got a real good prototype here."

The moral here is: sometimes we can help, sometimes we can't; but the advice is always worth thinking about.

Mea Culpa

Last month the Hack revealed his extreme prejudice by waxing cynically lyrical about one Mr Jack Toyer, rainmaker, who claims to have an electromagnetic energy generator that punches a hole in the stratosphere.

Unfortunately, the self same Hack was sent out to a press conference a little time later where some other inventor was releasing his rather less sensational but eminently more presentable invention, and he happened to run across Irene Vanderzwart, General Manager of the Inventors Association. This good lady promptly proceeded to berate the Hack for his lack of faith: "They laughed at Einstein," she said, and "think about all the great Australian inventions that have gone overseas because people laughed at them."

Yes indeed. Upon sober reflection the Hack must say a profound *mea culpa*. Indeed, one should never laugh at northern gentlemen with strange ideas, no matter how silly they sound.

SCOPE

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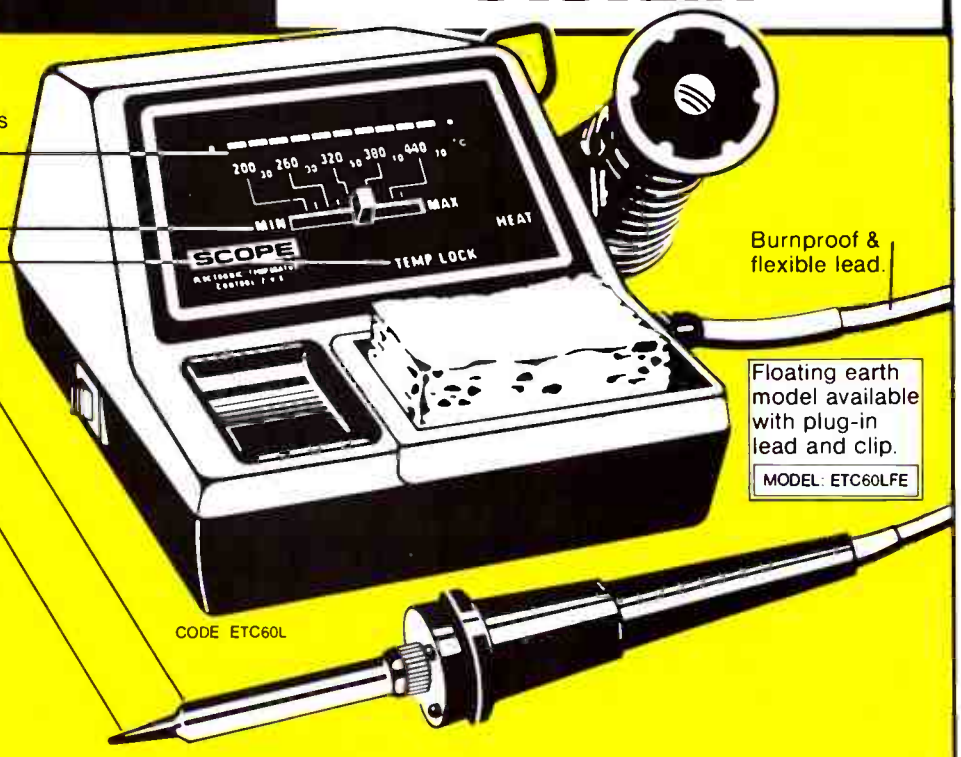

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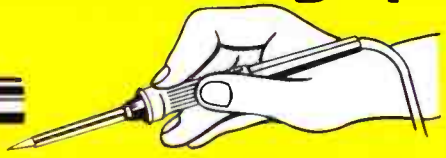

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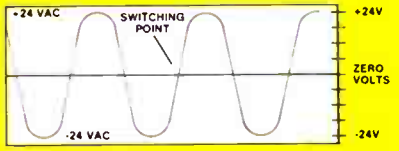

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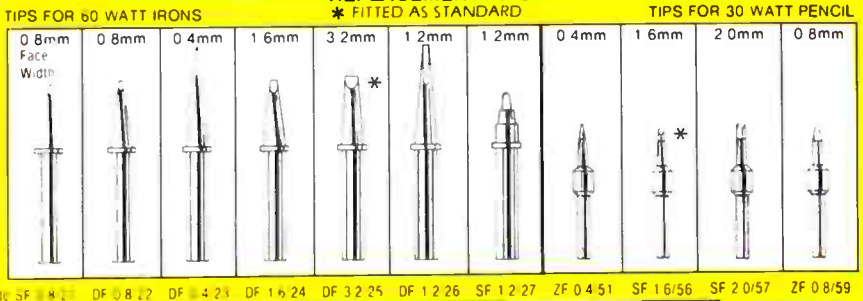

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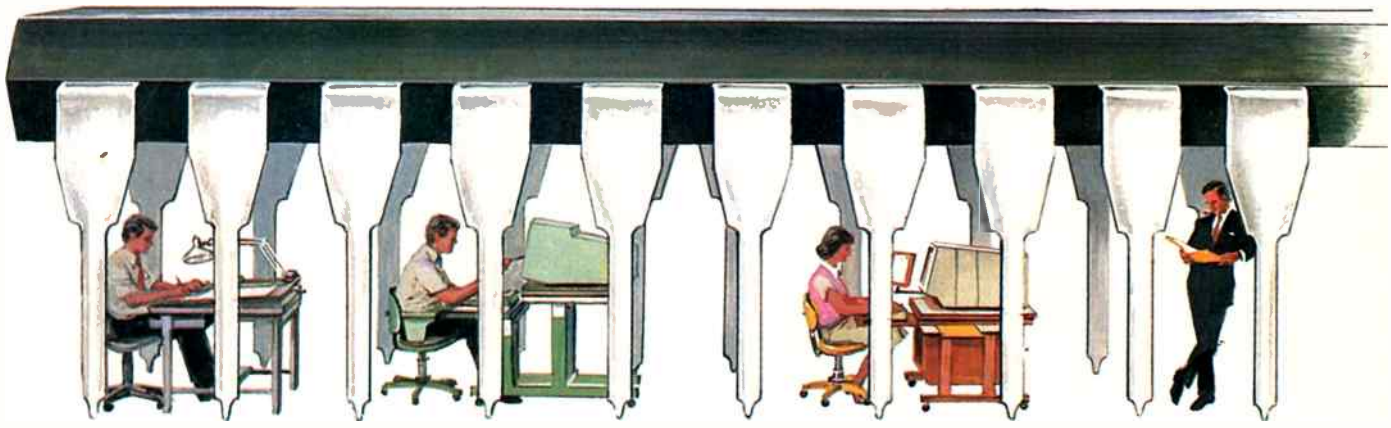

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