AUSTRALIA'S DYNAMIC ELECTRONICS MONTHLY!

Electronics Today INTERNATIONAL

eti

DECEMBER
1984

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'MINDMASTER'

Human-computer link to build

PROJECTS:

High quality radio microphone

PA Speaker columns

Two low-cost CROs reviewed

The TV set goes digital

SCOOP REVIEW New KEF Speakers!

PRICE BREAKTHROUGH!

Beeple: the $99 pocket pager

At last there's a pocket radio pager that YOU can afford.

The Beeple. A small, lightweight and reliable unit that costs a tiny fraction of previous models. It's a price breakthrough!

What's a Beeple?

It's an instantly accessible automatic radio paging system activated by a simple telephone call. Just dial up the special number and a 'beep' sounds on the Beeple.

Inside the Beeple is an incredibly sensitive radio receiver capable of picking up signals in really bad locations, plus the decoding & logic circuitry necessary to analyse which signal is being received.

All Beeples share a common radio frequency, which helps keep the cost way, way down. It's up to the Beeple to decide whether the signal is for it: if so, it sounds the beep.

Clever, isn't it!

Because each Beeple can have up to four different access numbers (and four different beeps) you can have a system where you know by the sound of the beep who wants you. It's so simple.

Even more, it has a memory facility – in case you're in the middle of an important meeting and don't want to be disturbed. Not even to tell you you've won the lottery and you don't even need to be at work any more!

Where can you use your Beeple?

Virtually anywhere in the Sydney or Melbourne metropolitan areas – and up to about 100km outside.

That means your Beeple should work from about Newcastle to Wollongong and out to the Mountains from Sydney. Or down to Geelong, out on the bay, down the Peninsular and up as far as Ballarat from Melbourne. (Obviously range is limited at the extremes by topography and conditions).

Later on, it is expected that Beeple will be available in all capital cities and possibly some larger country centres too. But that's in the future. Right now, it's Sydney and Melbourne.

Who needs a Beeple?

You do!

Businesses have recognised their value for years. Key personnel have been accessible at any time. Even staff 'on the road' have been contactable.

So why should John (or Jill) Citizen own a beeper?

Think of the times you've been away from home and needed to be contacted.

Sometimes trivial, sometimes important – but always impossible to do anything about.

Until now . . . with the Beeple:

Let's imagine Dad's at the station and wants a lift home: and you've gone next door or down to the shops. With the Beeple, you could go anywhere.

Or you go out to a show and spend the whole time wondering if the babysitter has everything under control. Take the Beeple along and you know you can be contacted if something really is wrong!

Or the kids arrive home from school and you're still out. They don't know what's happened to you. With the Beeple they can find out where you are.

Or an elderly relative or neighbour is ill: and you can't go out just in case they need help. With the Beeple, you're no more than a phone call away.

Or little Johnny goes out to visit his mates a few streets away. You start to worry when he hasn't come home and ring everyone you can think of. If he had a Beeple in his pocket one call would tell him to come home!

And there are thousands of other uses!

As you can see, it's not just Dad who needs one. Mums and Housewives find them indispensable. The kids can use the Beeple.

Everyone can use the Beeple. That's why it's called the Beeple: The Beeper for People!

Where does it come from?

Beeple is manufactured by the world-famous electronics giant STC, and is serviced by Voicecall, the largest private radio common carrier in Australia.

Because of Dick Smith Electronics wide distribution network, Voicecall suggested that we should include the Beeple in our product range. And seeing the incredible potential of this product breakthrough, we readily agreed!

How much does a Beeple cost?

Unlike most previous models of pocket radio pager, you buy the Beeple outright for the amazingly low price of just $99

Compare this with many of the 'leased' systems still around now which cost $40, $50 and more **per month!** The Beeple is incredibly inexpensive!

Charges for the Beeple service vary depending on the number of telephone numbers or "tones" you want. The more you get the cheaper each line becomes! Yearly charges are: 1 line $84, 2 lines $104, 3 lines $124 and 4 lines are only $144.

This includes the telephone line rental charge from Telecom, the use of the network of Voicecall radio transmitters to get your paging message out and a service and maintenance agreement which will look after your Beeple for you!

Even in the first year of operation when you have to take into account the yearly charge PLUS the purchase price, you will still be so far ahead of leased pager rates you'll be laughing.

The following year the savings are even greater!

And remember, if you use the Beeple in any type of business, the charge and the purchase price should be tax deductible!

How do you get a Beeple?

Simple! You go in to your nearest Dick Smith Electronics store in Sydney or Melbourne.

They'll be able to demonstrate the Beeple, show you how to operate it and, best of all, sell you one. Or more!

And they'll also be able (on behalf of Voicecall) to activate your Beeple **on the spot:** you'll walk out of the store with it completely operational! No messy forms to send away and wait weeks for authorisation. It's working from day one!

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DICK SMITH ELECTRONICS PTY LTD

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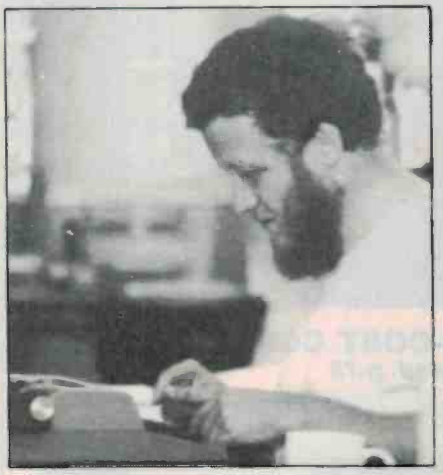
EDITORIAL



THE FESTIVE SEASON is, by tradition, a time of reflection on the past and rumination on the future — of taking stock, of looking backward and forward from a pivotal point, a fork in the road if you like.

What we've done in the past year can be seen in the magazine (for better or worse, depending on your point of view!). We've introduced a few 'new tacks' (in sailors' parlance) and time will tell if we're sailing in the right direction — or not. We've tackled a few 'issues' and, judging by reactions, that's something we'll continue to do. We've also 'brought back' a few topics we've not tackled for a few years — and with your support, they'll continue. So, for the past, we stand on our public record.

What of the future? Problem is, as soon as you predict the future — you change it! (Maybe I should stop right here!). Well, we have a few more 'tacks' on the drawing board (pardon the pun) for the good ship "ETI". Without letting any cats out of the bag, next year we'll be taking a close look at satellites and Australia, from both the users' and the industry's viewpoints — because 1985 will be an important year for Australia in this regard. We'll be taking a look at developments in the consumer electronics marketplace — for that will influence what products we'll all be exposed to, and buying (or not buying!) next year. And what about computing? The Australian scene is currently in something of a watershed on every front, from home computers on up, while the industry sorts itself out. We'll be in there — reporting, commenting (. . . stirring a little . . .). Projects? — keep feeding us *your* ideas and comments, that way we can come up with the sort of things generally in demand. But we have a couple of exciting developments percolating along there in the back room . . .

Ruminate on that lot in the afterglow of Christmas dinner! Season's greetings and a fulfilling new year to all our loyal readers, advertisers and colleagues from all of us here at ETI.

Roger Harrison
Editor

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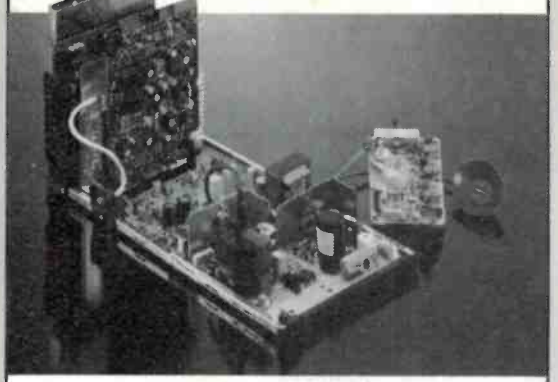

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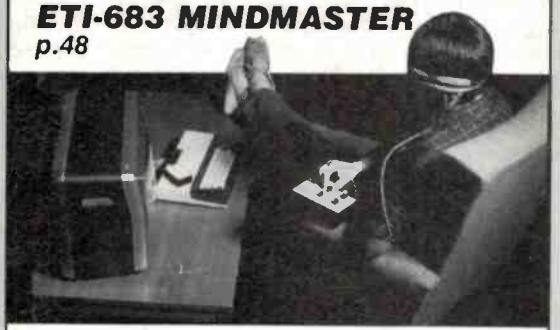

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NEWS

COLUMNS

DEPARTMENTS

This page is to assist readers in the continual search for components, kits, printed circuit boards and other parts for ETI projects and circuits. If you are looking for a particular item or project and it is not mentioned here, check with our advertisers.

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FEATURES

PROJECTS

REVIEWS

NEXT MONTH

'CHATTERBOX' VOICE SYNTHESISER
We promised this back in January . . . And here it comes! A voice synthesiser that can be driven from a Centronics or 8-bit parallel port on your computer. It features inflexion, is low in cost and simple to drive. Software provided for the Microbee, Apple . . . and maybe a few other popular ones.

SIMPLE DARKROOM EXPOSURE METER
Employing an 'opto op-amp', this simple project uses three LEDs to show 'under', 'over', or 'correct' exposure for photography enthusiasts who do their own B&W prints. The project costs under $20 and is easy to put together and get going.

JAPAN: REGROUP — ATTACK!
Dennis Lingane reports on the Japanese electronics and audio shows. It seems mass-market hi-fi is dead — long live "new media"! This authoritative report gives a breakdown on where the Japanese consumer electronics industry is heading.

MADE IN MY IMAGE
The video revolution will carry us far beyond what's offered on the surface. Malcolm Goldfinch philosophises on the implications of home video movie-making technology.

COMMODORE PLUS-4 COMPUTER REVIEWED
Not content with the success of their VIC-20 and 64 home computers, Commodore stride ahead with an interesting new machine. Mark Lingane reviews this 'new generation 64' — is it ". . . one step closer to the ultimate personal computer"? Maybe.

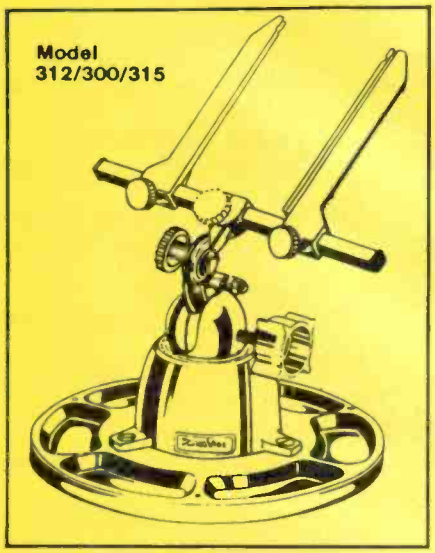
ADVERTISERS' INDEX

HOLD IT!

Anywhere you want it...

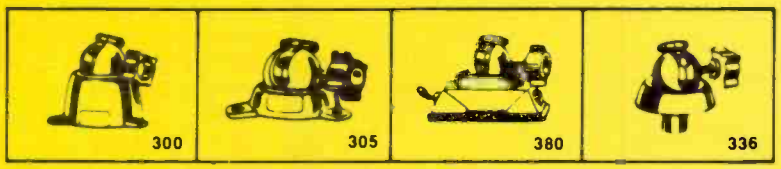
SCOPE PANAVISE

Work holding system with Interchangeable heads and bases.



1 TAKE A BASE

NOTE 300 & 305 CAN BE SCREWED DIRECT TO BENCH



300 STANDARD BASE
Holds all regular PANAVISE heads and Circuit Board Holders. The patented load control knob and exclusive split-ball feature have a range of tension which permits moving of work to any position desired

305 LOW PROFILE BASE
The Low Profile Base has all the tilts, turns and load control features as in the Standard PANAVISE base. Only 2½" (64mm) high.

380 VACUUM BASE
Moving the black-tipped lever arm attaches the Vacuum Base instantly with a firm grip, without marring, to smooth non-porous surfaces.

336 UP/DOWN CONVERTER BASE
An attachment for the 325 Up/Down Positioner giving the additional dimension of variable height (14" or 355mm)

2 ADD A HEAD

5 INTERCHANGEABLE HEADS tilt, turn and rotate, then lock in any position.

303 STANDARD HEAD
The top selling head. It has jaws 2½" (63.5mm) wide which open 2¼" (57.2mm). The tough yet gentle nylon jaws have a satin finish to improve grip.

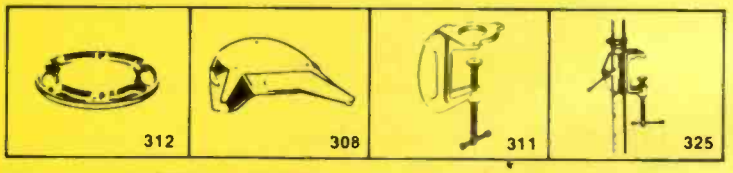
315 CIRCUIT BOARD HOLDER
(Extra Arms Available)
Holds p.m. boards any shape and size to 12" (304mm) wide (including the S100) exactly where you want them — flat, vertically, or any angle in between, when used in a PANAVISE base

366 WIDE OPENING HEAD
Opens a full 6" (152mm) with jaw width of 1¾" (44.5mm). The contoured neoprene jaws provide a cushion over the steel jaw plates to gently yet firmly hold delicate items

337 FIXTURING HEAD
Permanent fixturing for production line assembly or repetitive repair work can be designed and bolted to this head easily with its six slots and bolt holes. The flat ground surface is 5 3/8" (137mm) in diameter

376 SELF-CENTERING HEAD
(Extra Wide Opening Head)
Double Action Jaws. Allows fast opening and closing. Large Capacity - Opens to a full 9". Reversible Jaw Pads - Flat one side Fits all PanaVise series 300 bases.

3 VARY THE ATTACHMENT METHOD



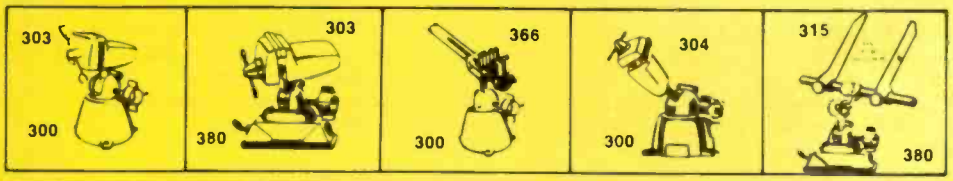
312 TRAY BASE MOUNT
The cast metal Tray Base Mount holds either the Standard or Low Profile PANAVISE securely and yet gives easy portability. It has six individual trays moulded into the new Base Mount

308 WEIGHTED BASE MOUNT
This husky cast iron Base Mount weighs 5 lb (2.3 kg.) giving it compactness and stability

311 BENCH CLAMP-MOUNT
For the 300 or 305 base, it clamps to the edge of any work bench or table with a thickness of 3½" (89mm) or less

325 UP/DOWN POSITIONER
For 336 Base. Sit or stand when you work with the Up-Down Positioner. Adjusts up or down 14" (356mm) in seconds. Clamps to benches 2½" (63mm) or less

HERE ARE SOME TYPICAL COMBINATIONS



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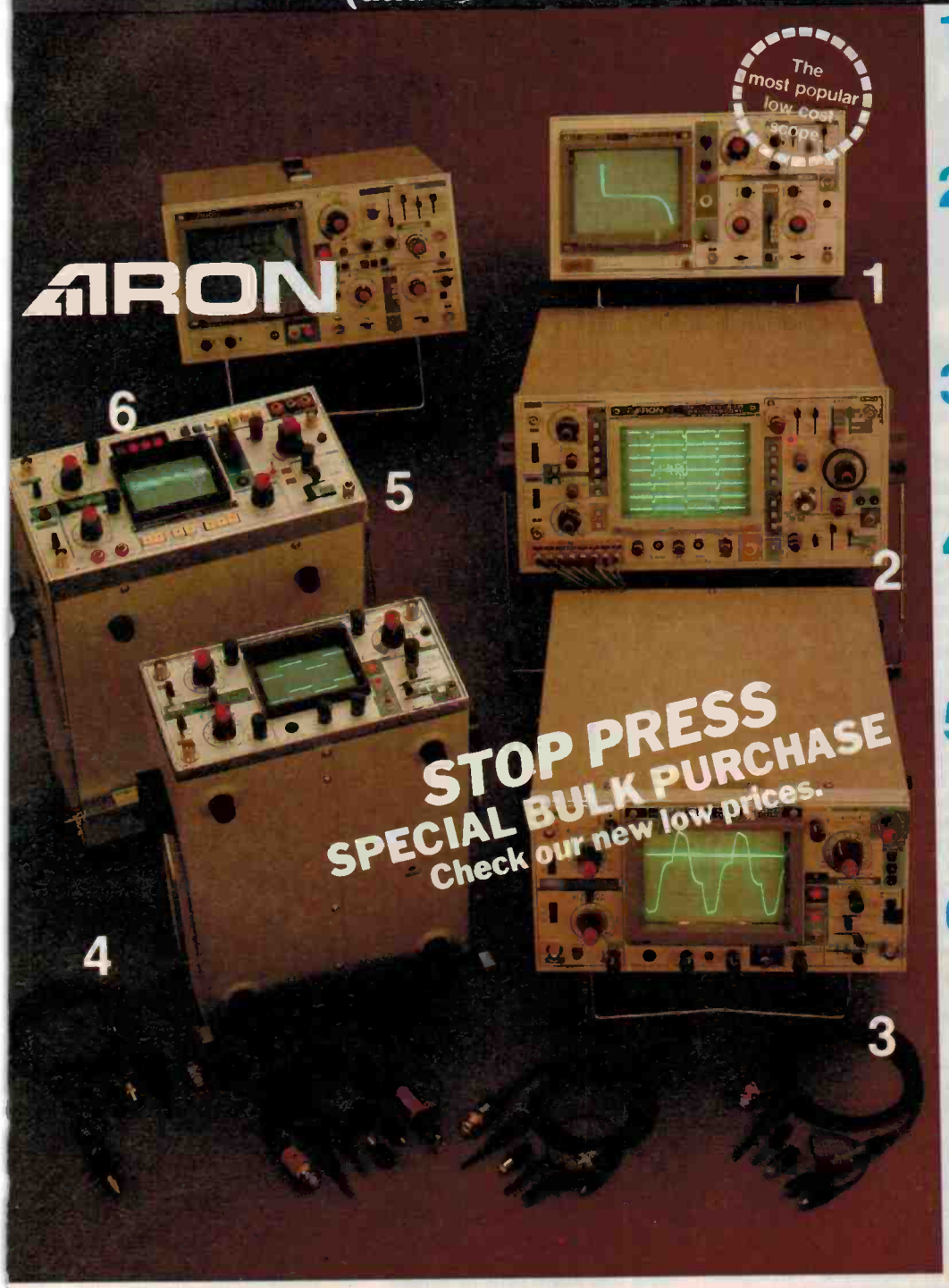

1 BS601 - 20MHz/5mV with Built-in Component Tester

$465 *ex tax* *$538 tax paid*

- Check components on screen
- 19 range timebase • Triggers to over 30MHz • 17nS risetime

2 BS810 - 100MHz/1mV with 4 Channels and 8 Traces

$2295 *ex tax* *$2708.10 tax paid*

- 2nS/div max sweep time
- Alternate time base with B ends A mode • Variable trigger hold-off
- Independent position controls
- Signal delay

3 BS625 - 45MHz/1mV with Signal and Timebase Delay

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- Single sweep • Trigger delay
- 7.7nS risetime • X, Y, Dual, Chop, Add, Subtract etc

4 BS310S - 15MHz/2mV Battery Portable

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- Ideal for field service use
- 2 hour operation from built-in NiCads • Automatic re-charging
- Auto trigger free run • TV sync

5 BS320 - 15MHz/2mV with Digital Storage and DMM

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- Built-in 3½ digit multimeter
- Digital storage mode • Trigger delay • X-Y mode component tester • 3 channel operation for 3-phase measurements

6 BS635 - 35MHz/1mV with Alternate and Delayed Timebase

$675 *ex tax* *$781 tax paid*

- 21 range timebase • 100mS-1uS trigger delay • Front panel trace rotate • Multi-mode display

Optional carrying cases available for all 'scopes.

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SP100 - 100MHz Probe

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Jumbo display

Elephant's eye view! An outdoor videos display measuring 52.15 m diagonally; a huge attraction at Japan's Expo '85 science and technology exposition.

Visitors to next year's Expo '85 science and technology exposition at Tsukuba, approximately 60 km north of Tokyo, will be treated to a widescreen outdoor video display that measures over 52 m diagonally.

Developed by Sony, the display's brightness measures over 1500 footlamberts — more than 10 times that of home TVs — for viewing in daylight. Optimum viewing distance is about 200 metres, but the display should be visible from 1 km away.

For Satoshi Shimada, general manager of the Product Planning Centre, this display provided a second chance to pioneer in large matrix array panels. Back in 1968, he developed what he claimed was the world's first full-scale matrix array display for a TV set. Its 2.62 m diagonal size was large for its time. The incandescent bulbs used as light-emitting elements were not elegant, but their use made it possible to develop the project without taking the time to invent a new type of display device.

This time around, though, Shimada did develop a new display device. It is, in effect, an oversize vacuum fluorescent tube, but totally unlike those used in calculators or test equipment. Shimada's cell can display colour trios — individual side-by-side rectangles of red, green, and blue.

The individual cells have three electron flood sources (one for each primary colour) with a common cathode. Actual electron sources are electrons passing through individual grids, which are maintained at low positive potentials. (This type of configuration is known as a diode electron source).

Unlike conventional cathode-ray tubes in which electrons leave the gun at high velocity, all acceleration in these cells occurs as the electrons travel from the electron sources to the phosphor screen. Total accelerating voltage at the phosphor screen is about 10 kV for high brightness and efficiency.

The cells measure 80 mm wide by 45 mm high by 25 mm deep. They are bundled in 4-by-6-cell units, which are assembled to form the 40-by 25 m screen with 378 lines vertically by 400 colour trios horizontally.

The new display differs from the conventional picture tube in which picture elements in alternate interlaced fields are illuminated in sequence as the electron beam scans across the screen. For starters, the signal is converted to a noninterlaced format with 60 complete frames. Moreover, processing and driving circuits convert the video signal to a parallel format with the primary-colour dot of each pixel controlled by a separate 8-bit digital pulse-width-modulated signal. All dots are turned on simultaneously, and the fraction of the frame interval that each remains on is proportional to brightness. A high duty ratio makes possible the high brightness at reasonable accelerating voltage and beam current.

Shimada says he is particularly proud of three aspects of the display. The display tubes are designed for constant brightness despite manufacturing differences or emission slump during operation. And although the average power of 800 kW appears high, he claims that 90% of that power is in the electrons that strike the screen to produce visible emission. Moreover, he says that the display's 151 200 colour trios far exceeds those of smaller billboard-like displays.

Shimada says Sony has no plans for the unit after the exposition.

More Oz tech going to USA

AN artificial intelligence system which its makers claim is a worldwide breakthrough was unveiled in Perth.

The West Australian Government has an eighth share in the development, now under negotiation for manufacture both in Australia and the United States.

The project, named HI-Q, is said to be a new approach to artificial intelligence. One of the keys to the security of the system, a large-scale integrated custom chip, had been commissioned from a US manufacturer.

The new technique has been developed by Formulab Technology (Australia) Pty Ltd, which three yars ago "stubbed its toe" on a particular effect.

In September last year a graphics recorder using the system of autonomic intelligence attracted widespread interest at an international electronics exhibition in Sydney.

Formulab was approached by companies from several countries.

Part of the WA Government's support of the project was the investment of $225 000 and a place in the State's new technology park.

About 150 people are expected to be employed on the venture.

The chairman and managing director of Formulab, Mr Tony Richter, said the advantage of the new system was that it was extremely compact and cost as little as five per cent of equipment that might perform similar functions.

Mr Richter expected the recorder and other products to be on the US market by next January and in other countries later. It would also be manufactured in Australia, for sale here, in Asia and Europe.

The graphics recorder is described as a computer-like structure incorporating non-volatile solid-state cartridges, advanced enough to be analogous to the human brain.

The record made possible the high-speed storage of more data than ever before in an extremely compact form, Mr Richter said. The recorder could, among other tasks, produce graphics for promotional and teaching purposes. Another capability was the recording of complete books in its circuits, which could be played back, cassette-style, on the recorder and read on a screen.

The computer language used is called Confluent by its authors because it has many streams, the values of which merge and expand the language.

Hi-tech from CSIRO

The CSIRO Division of Mineral Physics is in the process of selecting commercial partners to manufacture and market SIROLOG borehole logging systems. And it hopes that proven mining company interest in acquiring SIROLOG equipment will stimulate Australian instrument and service companies to enter a high technology field which has considerable Australian and worldwide potential.

These direct measuring systems can be applied to the quantitative measurement of the ash content of coal. In open-cut coal mines, for example, SIROLOG could be used to log boreholes and obtain information that would aid mine development and production. It could also serve as a useful aid in exploration.

In mine production, the immediate analysis allows informed decisions to be made on the sequence of mining, the need for washing and the suitability for blending. In addition, SIROLOG indicates precisely the location of the coal seam/floor boundary.

A major problem in using conventional, chemical-analysis techniques is to obtain representative samples from non-core drilled holes.

While chemical assaying is precise for the samples received in the laboratory, it can only be representative of the coal *in situ* if the sampling is accurate and samples are carefully prepared for the chemical analysis.

For underground coal mines the opportunity to use the considerably cheaper percussion drilling method, in preference to diamond core drilling, is an attractive option when supported by direct SIROLOG analysis of material around the drilled holes.

On its own, percussion drilling does not provide a representative sample for chemical analysis. But, together, percussion drilling and SIROLOG analysis would provide a cost-effective means of planning the future exploitation of underground coal leases.

Both short-term exploitation strategies and long-term planning for maximum mine life are possible, based on sound knowledge of the resource.

The Sirolog techniques for coal logging are well established and have been demonstrated in black coal deposits in NSW and Queensland.

The Division hopes to spark the development of an Australian and overseas market in which companies would either buy their own equipment or contract specialist logging services.

To that end, while selecting Australian firms to develop and market Sirolog systems, the Division is to design and test a Sirolog coal-ash system for an initial client.

This system is based on a spectrometric gamma-gamma technique. A gamma ray source in the Sirolog probe irradiates coal surrounding the borehole and back-scattered gamma radiation is measured spectrometrically by means of a scintillation crystal detector. Signals are amplified and transmitted by cable to a pulse height analyser system at the surface.

The data are then processed by computer, stored on magnetic discs and plotted on a chart recorder which gives a direct reading of ash content. Another version, which also identifies major constituents in the coal, is based on the spectrometric neutron-gamma ray technique.

Commercially available coal logging devices measure the density of strata and rely on a correlation between measured density and ash content. Sirolog avoids the problems involved in this method by measuring ash content directly, and it has the further advantage that it can tolerate variations in borehole diameter.

The division sees Sirolog representing the next generation of coal-logging technology. The project was supported in part by the National Energy Research, Development and Demonstration Council.

The Division's expertise, incidentally, extends well beyond the logging of coal. It has tested the technology on other ores including those of iron, manganese, nickel, and copper. Further development of Sirolog for use with these and other metalliferous minerals is required before fully commercial systems will be available.

For more information contact **CSIRO Division of Mineral Physics, PO Box 124, Port Melbourne, Vic 3207. (03) 647-0211.**

The ultimate micromanipulator

Since its introduction some 18 months ago, many new applications have emerged for the Huxley-Goodfellow micromanipulator developed by Goodfellow Metals of Cambridge England, from an original design by Sir Andrew Huxley, President of the Royal Society.

Employing different probes, the micromanipulator is currently being used in marine biology institutes in France and Britain, in electro-optics at Plessey and by the Max Planck Institute in Germany, by Cambridge, London, York and Sydney Universities in anatomy, embryology, botany and physiology; and for the alignment of optical fibres by a commercial laboratory in Australia.

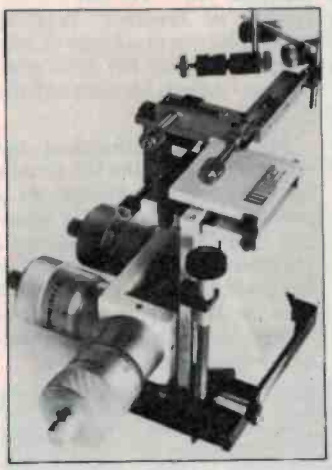
In Japan both the National Institute of Biology and the National Institute of Physiology have bought Huxley-Goodfellow micromanipulators. Elsewhere the chemistry for manipulating single crystals; in genetics for the removal or reimplantation of nuclear material; as well as in microelectronics and microwave research.

The micromanipulator allows rapid placement in the vertical and both horizontal axes and very fine control in all three planes.

Coarse control is provided independently in each of the three axes by three separate rack-and-pinion motions, which allow rapid initial placement but can still position to an accuracy of 0.1mm without backlash.

Ultra-fine control is provided by micrometers, one in the HG-1000 and three in the HG-3000. One small division on the micrometer represents a movement of the probe of 0.2 micron to give repeatability with an accuracy of ±0.1 micron.

For further information contact **Goodfellow Metals, Scientific Instruments Division, Cambridge Science Park, Milton Road, Cambridge CB4 4DJ, England.**



GaAs chips

Research expected to lead to a new generation of ultra-high speed microelectronic devices — capable of out-pacing today's silicon chips — will begin this month at the University of California, Santa Barbara.

A consortium of the USA's major microelectronics companies is to develop digital integrated circuits from gallium arsenide.

GaAs has the same basic structure as silicon, but electrons move faster in it.

"The objective is to demonstrate a very high speed device, but to get there, we have to solve a wide range of fundamental problems," said James Merz, the project director. "To date, the industry has concentrated on developing silicon. It is well understood, easily fabricated, and leads to good integrated circuits. But gallium arsenide is a relatively young material in terms of our scientific understanding, so there are basic aspects of it that we have yet to understand.

BRIEFS

Standards Components has announced that its name has changed to Standard Communications. This follows a decision to concentrate on three products ranges in the communications field. They will now market Electrophone transceivers, Hitachi test instruments and Kingray TV equipment.

Printronics, Australia's largest manufacturer of printed circuit boards has commenced the manufacture of multilayer boards. Printronics claim this is the first fully commercial venture in Australia to produce multilayer boards. According to the company volume production will allow the company to be very competitive with imports and general specifications will be up to military standards. The maximum number of layers will be 14.

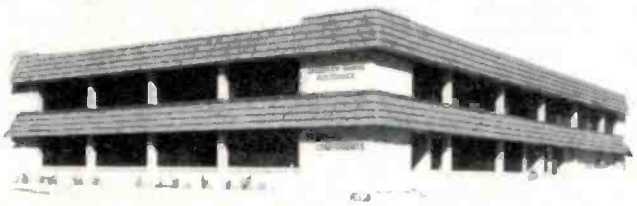
Acme electronics, the business unit of Hardie Trading, is moving its office and warehouse to 205 Middleborough Rd, Box Hill, Vic 3128.

Mr Tony Richardson has joined Elmeasco instruments as Industrial Products specialist. He will be primarily involved in selling Fluke industrial products. Before joining Elmeasco he had extensive experience in sophisticated process control equipment in Europe and Australia.

The Bayswater branch of Telcon Australia has outgrown its present premises. They are now situated on the corner of London Rd and Amstead Drive. The new premises has almost twice the space of the old one.

Mr Damien Walters has been appointed General Manager of Intergraph Corp. Mr Walters has a degree in Electrical Engineering and a background in design drafting and the electrical trades. He has spent the last seven years with GEC it a variety of roles.

Mr Greg Hughes has been appointed to the position of General Manager of AWA's Ashfield plant. Mr Hughes is an economics graduate from Sydney University and has been with AWA for the last twenty years. He was previously the Deputy General Manager.



LSE Electronics, the Melbourne based manufacturer of State and auditorium lighting has revised its distribution system. New agents have been appointed in Sydney and Adelaide. In Sydney, Grafton Lighting and Sound of Campbell St, has been appointed, while the Adelaide representatives will be Osmond Electronics. Three Arts Services remain the company's Melbourne and Victorian outlet.

The Department of Communications has announced that its Communications Development Division will be headed by Dr Cameron Hazelhurst, presently of the Australian National University. His appointment is for three years. He has a background of research, teaching and publishing in a range of academic areas and has held positions at Oxford, Monash and the ANU.

Mr Bernie Richardson has transferred from the UK to take up a position with Philips. He is now Product Manager for Scientific and Industrial Equipment. He joined Philips in 1966 and in the period 1974-79 was involved with the UK export division, in which capacity he had many contacts with Philips Australia.

Telcon: at your service.

Philips has announced the appointment of Mr John Boutcher as Divisional Director for Corporate External Relations. Mr Boettcher has more than 26 years with Philips. He will act as the interface between Philips and government, university and the private sector.

The Oxford English Dictionary is about the celebrate its centenary year with a computer aided update. The $10.8m deal involving Oxford University Press and the British Government will be to transcribe the 21 000 pages of words into a database. The first complete edition of the dictionary will be available on tape, disk or online. At present the complete Oxford consists of 12 volumes and four supplements.

Graphtec has just released a new ROM for their MP10000 Graphic plotter. The ROM will change the software protocol of the MP1000 to run under the control of the Computer Aided Design Software system called Autocad. Australian agents are Electrical Equipment, 192 Pacific Highway Arncliffe NSW 2205.

Avon, the US cosmetic giant, renowned for its 'Avon calling' sales staff is giving up its pen and paper image and moving into computers. From now on, all the Avon ladies will be equiped with a Swedish designed Micronic hand-held computer. The operator will be able to use a modem to communicate orders directly to the warehouse, thus speeding up the ordering process. The initial order, for 1000 terminals has resulted in specific software being adopted for the Avon ladies.

EDWIN WESTWICK

It is with some shock and regret that we honour the death late in October of a respected colleague and competitor, Edwin Westwick, Managing Editor of *What's New in Electronics* and a Director of the publishers, Westwick-Farrow Pty Ltd.

Edwin was well-known in the Australian electronics industry, having been Editor of Thomson Publications' *Australian Electronics Engineering* for 10 years from 1970 to 1980. British born, Edwin had previously worked on trade journals in the UK and France prior to coming to Australia in 1964.

In 1980, Edwin and a colleague from Thomsons, Adrian Farrow, teamed up to form Westwick-Farrow Pty Ltd, and started publishing what rapidly became Australia's top electronics trade journal, *What's New in Electronics*.

We extend our condolences to his family and to Adrian Farrow and the gang at What's New.

Roger Harrison
Editor, ETI

How to succeed at overseas trade fairs

Many companies miss the perfect opportunity to market their new products and innovations overseas because they do not use trade fairs and specialised technology exhibitions to proper advantage, according to Thomas Wright, managing director of the product and technology transfer company, TechnoProduct.

"So many companies trying to break into the export market for the first time have little idea of what is involved in entering into a trade fair or other forms of overseas marketing," Mr Wright said. "Just establishing contacts in other countries is time consuming."

TPR specialises in representing Australian companies overseas and will also explore export markets for new products and innovations. The company has successfully placed many Australian innovations and products in export markets.

Direct brain-computer hookup

Present methods of non-keyboard data entry, such as the use of mice or touch-screens, are soon going to lead to remarkable man-machine interface techniques, including direct brain-computer communications, according to a report from the US based market research and consulting firm, International Resource Development.

Acdording to Laura Conroy of IRD, the early pc-brain interfaces will be based on inputs from electrodes placed in selected spots on the user's neck and temples, similar to those used in today's lie detector machines. But by the mid-1990s they will be replaced by human microchips, or 'biochips', that will enable direct brain-to-computer links.

Possibilities for improvements in efficiency are endless; but so are the possitibilities for abuse. For example, hooking up two computers to two brains could let one engage in theft of thoughts or such confidential material as military information or plans for inventions.

Although seemingly far-fetched, these schemes are derived directly from existing research that has produced many products of the future for use in military control systems. Laser-based sighting systems that utilise the centre of the pupil to direct the crosshairs over the target are already in use, for instance.

According to the IRD study several factors are creating a huge demand for less expensive, and more efficient operator-to-computer interfaces.

"An important goal," says IRD's Conroy, "is to reduce the cost of data entry by shifting the burden of the job to the hardware, and away from the operator." She adds, "The new technology allows companies to shift data entry facilities to sites where the data is collected, eliminating several steps in the collection and use of the data."

The report includes an in-depth description of the positioning going on for the coming battles over market share. Technological developments have placed many products in direct competition with each other. Movable mice, stationary mice, touch screens, light pens, touch pads, digitisers, joysticks and trackballs all have overlapping features. The major factor in consumer acceptance is whether or not efficiency is increased. Tests have shown that users are willing to learn to use new and more complicated methods of data entry if their efficiency or accuracy is increased.

Kiwi review

The New Zealand National Electronics Development Associaton (NEDA) has just released its 1984 review.

The publication gives a broad overview of the èlectronics industry. Last financial year it grew at a rate faster than any other sector of the economy. Inspite of a generally dismal year for New Zealand economically, manufacturing of electronic products in the industrial professional sector increased by 15%, and in the communications field by 45%.

The report lists key organisations and people in various sectors. Research being done in universities and at government research bodies is listed, as is development work within some of the large companies and industry organisations like Tasman Forestry

For a copy of the review contact **NEDA at P.O. Box 9092, Wellington NZ (4) 84-5688.**

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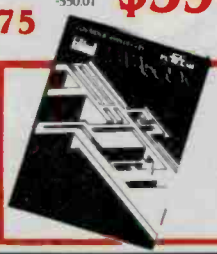

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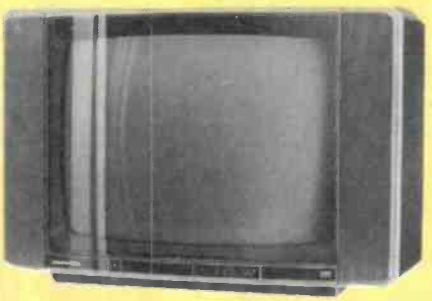
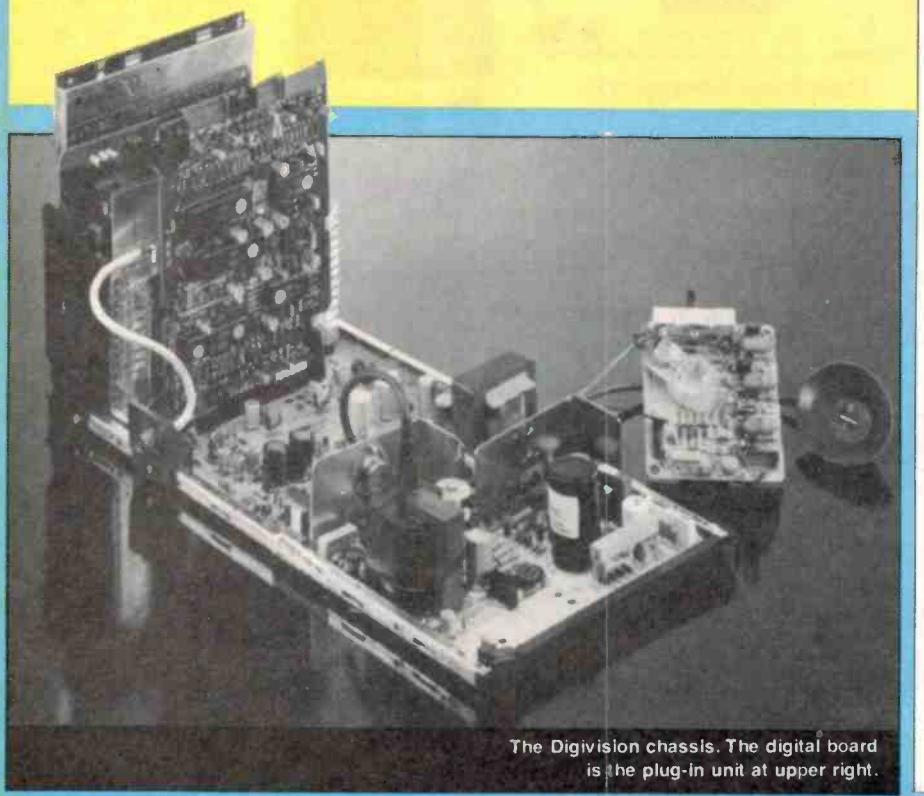
The TV set of the future will use digital techniques for most, if not all, of its functions. The process of converting to digital design is anything but easy and the process is likely to be long drawn out. It has already started, with some amazing new designs in workshops, but it's unlikely we will see true digital TV before the twenty-first century.

ITT's Digivision.



THE TV SET GOES DIGITAL

Jon Fairall



The Digivision chassis. The digital board is the plug-in unit at upper right.

THE SMART MONEY is betting that by the early 1990s most of the TV sets sold around the world will have digital circuits. Everywhere engineers are racing to be the first to put out a completely digital design. And the electronics giants of Japan, Europe and the US are watching them carefully.

There have been some successes already. In Europe the ITT subsidiary Intermetall has produced a kit of five VLSI chips that digitise the vision path between the demodulator and the output amplifier. According to ITT, this represents the integration of almost 300 000 transistor functions. Motorola has a similar set of chips it calls the System 4 that mixes digital and analogue functions on the chips.

There has also been considerable progress towards a digital frame store (DFS). A DFS is a device that stores the whole picture (frame) as a series of digits in one set of memory. In Europe, Philips has unveiled the first primitive model and Sony in Japan seems to be heading down the same track.

TV designers have been quick to jump on these developments. Virtually all of them now have prototype sets up and running that use digital chip sets. Sony has already released one in Japan and plans to release it here within the next two years. National, likewise, has released its first digital TV in Japan, using the ITT chip set, but there are no plans yet to release it in this country. Hitachi also claims to be working on one, but according to its Melbourne office, the details are still "confidential". The primary US contender is the Zenith Corporation, which has a prototype up and running.

Advantages

So, what's all the fuss about? Why digitise TV sets at all? Well, there are some fairly predictable answers: digital sets are claimed to offer greater immunity to noise and ghosting, better resolution, and ease of interfacing to other digital sources like personal computers and videotext systems. They also offer the designer the ability to do very sophisticated manipulations on the image data, manipulations that would be virtually impossible in a reasonably priced analogue set.

Looking down the track just a little way, say within the next ten years, designers are looking at sets with 1250 non-interlaced lines, and flicker-free pictures of unparalleled clarity. They would be hardware independent of the transmission format, requiring only reprogramming of their DFS to handle any of the standards now in use, (or any that might originate in the future).

Another facility that will be standard on most of these sets will be second source windows. These are small insets that can be made to show the output of a second source, like a VCR or video camera. The user will be able to select the size of the window and position it anywhere on the screen, as well as independently controlling brightness, colour etc, just as for the main screen.

History

Digital techniques were introduced to TV sets in the early 1960s when remote control

equipment began to appear in top-of-the-line models. Microprocessor based systems followed quickly. Text information systems like Teletext and Viewdata began to appear in the mid to late 1970s. They all require some digital processing before being delivered to the analogue circuitry of the video amplifiers.

Until quite recently though, digital TV has taken a back seat in most research labs to high definition, wide bandwidth systems. The conventional wisdom has been that more gains could be made more quickly by developing analogue technology. Modern top-of-the-line analogue systems have superb definition. They can also be made very small. In November 1983 Philips unveiled a black and white set with all its essential functions on a single IC. Two chip colour sets have also been demonstrated.

But even as this trend towards large scale integration has been going on there has been a slow but steady increase in the amount of digital design being included in the average circuit. Clive Sinclair (the flamboyant British designer of the ZX80/81 and Spectrum computers) has shown a composite digital/analogue chip set intended for use with his up and coming flat screen TV. While most of the signal path is conventional the deflection circuits are all digital. Motorola has also gone a long way down this track with its System 4 design. It also uses a composite analogue-digital design.

At least part of the problem with developing digital designs has been that while digital processing is conceptually far easier than analogue, it takes a lot more components to do the same job. This in turn implies a far more complex circuit, with associated manufacturing and servicing expenses. The only way to keep cost down and quality up is with large scale integration. The problem is that the very large number of components that need to be integrated pushes the state of the art to the limit.

So there was a certain amount of surprise in the industry when, in 1982, Intermetall announced the creation of a completely digital video and audio section called, with alarming originality, the 'Digivision' chip set. It was a five chip set with three of them handling the video signal: a coder/decoder (codec), a processor and deflection processor. The audio was carried on the other two. In order to make the system run it also required a microprocessor, an EEPROM and a clock, giving an absolute minimum part count of eight ICs plus a few capacitors. The managing director of ITT Semiconductor, Lubo Micic, has been quoted as saying that this represents just the first step in an advance that will see the creation of an entirely digital design on a single chip.

How it works

Given the fact that it works digitally, Digivision is a very conventional system. At block diagram level the circuit could be that of any of a hundred and one other analogue sets. The digital processing begins at the end of the IF chain after the AM RF signal has been detected, and the video and audio ▶

THE ITT "DIGIVISION"

The Digivision 3786 TV from ITT in Pforzhelm, Germany, is touted as the ultimate in modern digital technology, with built-in videotext decoder and newly-developed three-way loudspeakers.

The novel feature of this TV is that the picture and sound signals received from the transmitter are processed digitally, and the electron beams which 'write' the image onto the screen are also digitally controlled. According to ITT's press release, international experts refer to this advance as the greatest technological leap since the change from black and white to colour television.

The analogues of the picture and sound signals are converted into digital form, then stored and processed by the TV's circuitry. This means that disturbances which often occur during the normal method of processing these oscillations become ineffective; as long as the signal remains 'perceptible' the TV can process and 'restore' the signal exactly without influence from external disturbances such as distortion and noise, ITT claim.

A further advantage of the digital system is that it can check and, if necessary, correct itself to a certain extent. The Digivision TV does this in the following way:

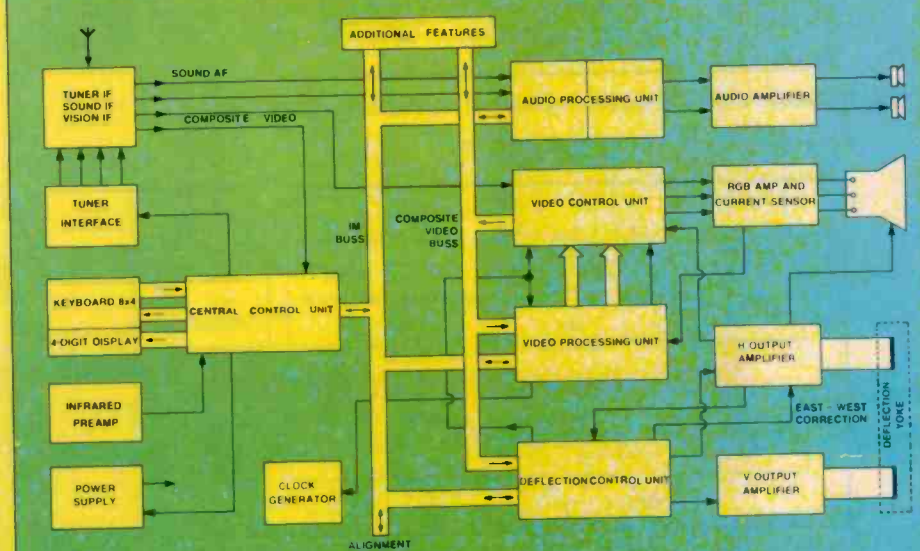
All data important for optimum picture reproduction are entered into an electronic memory at the production stage. Whenever the TV is switched on, it compares the data received with the data stored. If there are any deviations between the two, for example as a result of the natural ageing process of the picture tube or the beam deflection circuitry, they are automatically corrected. The result is that the colour picture quality should stay exactly the same as when the set was new, say ITT.

Since videotext employs digital technology, it is ideally combined with the new ITT TV set. This means the videotex decoder is not an expensive extra, as with other TV sets, but a standard component of the set. Increased rellability could also be regarded as a standard feature, since just seven computer chips have replaced around 300 conventional electronic components, with the obvious advantage that there are 300 less components to go wrong!

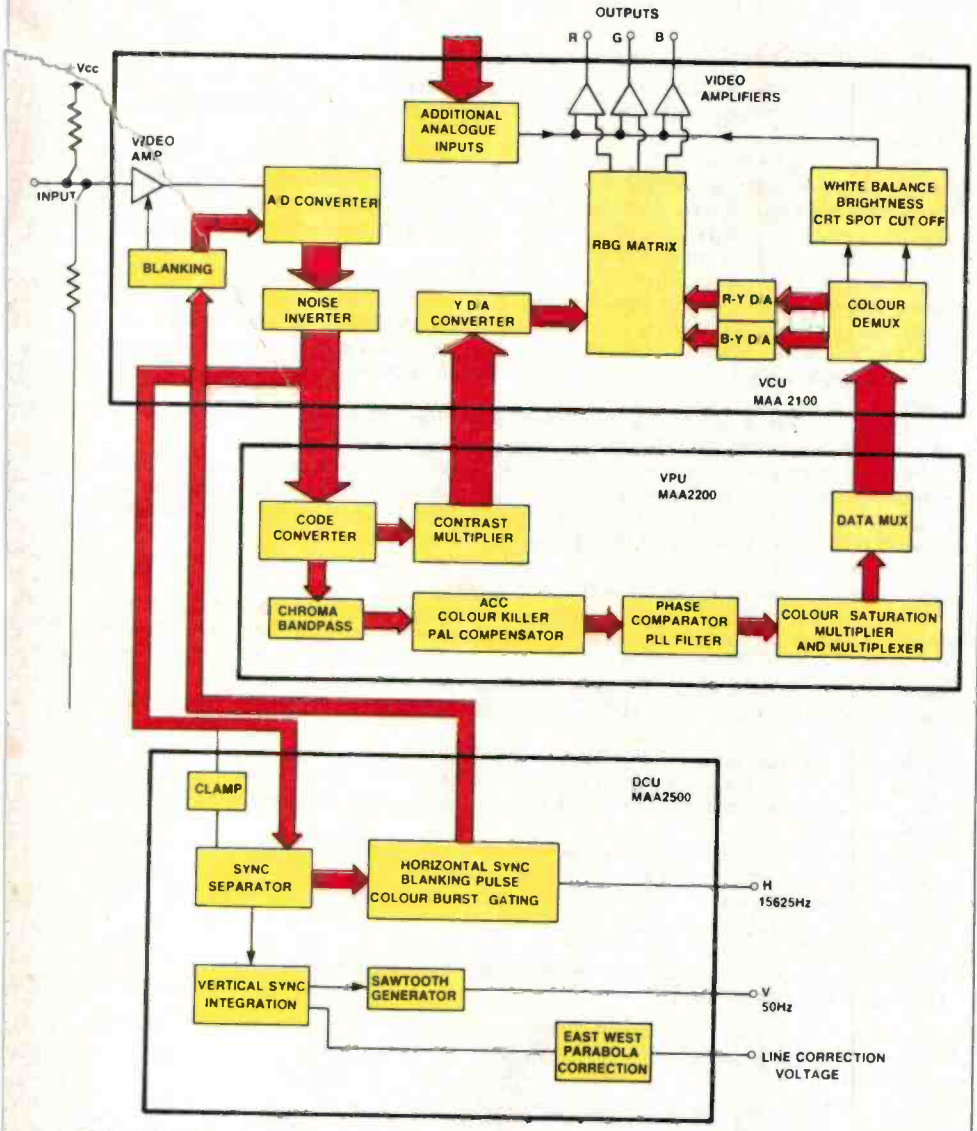
Owing to the inclusion of the ITT-developed 'OSCAR' tuner (Omni-System Cable and Antenna Receiver), the Digivision has a secure future when cable TV arrives. Altogether 99 channels can be received, 30 of which can be stored and selected using the remote control device.

Audio output is 2 x 20 watts (music power). Bass and treble reception can be varied by separate controls, and there are connections for headphones, external loudspeakers and a stereo system. Video recorders can be connected via the AV socket, and a PAL/Secam decoder can be fitted on request.

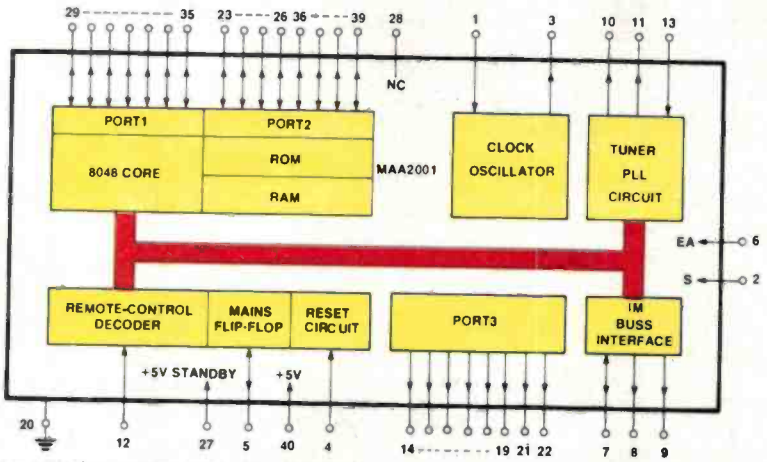
The dimensions of the Digivision TV are 80 x 55 x 49 cm, and its colour scheme is brown and silver. It is imported and distributed by **Falk Electrosound, 28 King St, Rockdale, NSW 2216. (02)597-1111.**



Digivision block diagram. Not all that different to modern TV sets, except that most functions are digitally processed.



Inside the blocks. Showing general arrangements of the VCU, VPU and DCU sections.



Inside the CCU. The 'smart heart' of the Digivision.

signals split up.

The video signal is passed to a network of three chips: the video codec unit (VCU), the video processor unit (VPU), and the deflection control unit (DCU). The analogue signal is fed initially to the VCU where it is converted to a 7-bit wide word via a pulse code modulation (PCM) process. The first stage of the operation is to chop the analogue signal in a process known as pulse amplitude modulation. This results in a series of bits with amplitude directly proportional to the amplitude of the analogue wave. The amplitude of each of these bits is then sampled by the pulse code modulator and turned into a binary number between 0 and 255.

This 7-bit word is then put out on to a buss that connects to the other two chips in the video processing section. The VPU takes the luminance and chrominance information, while the DCA takes the sync information. The chip set now performs a series of digital manipulations on the data directly analogous to the equivalent analogue process. The DCA contains a sync separator, where the horizontal information is separated from the vertical. The vertical 50 Hz information is put through a sawtooth generator to derive the control signal, and also through an east-west parabola to generate a correction signal for the tube.

The horizontal sync pulse, running at 15625 Hz, is used to generate the colour burst gating pulse and the various blanking signals. It is then fed out as a clean pulse from pin 31 of the DPU. This pulse can then be used to drive the output stages directly.

Meanwhile the VPU is processing all the colour information. A code converter on the input separates chroma and luminance information and performs all the usual manipulations on them. The luminance information is put through a contrast multiplier and limiter and then fed back to the VCU as an 8-bit parallel word.

The chroma information follows a slightly more complex path. After passing through the PAL compensator, colour killer decoder and phase comparator the two signals (R-Y and B-Y) are multiplexed together on a four line buss and passed back to the VCU.

In the VCU the luminance information is converted back into analogue form and applied to the RGB matrix. The chroma information must be demultiplexed into its component R-Y and B-Y signals before being converted into analogue signals and applied to the matrix. The demultiplexer also generates signals for white balance and CRT cut-off. The component R, G and B signals are amplified before leaving the chip and then passed to the video amplifiers for generation of CRT control signals.

In parallel with this video processing, the audio signal is also being processed. This is a two chip network with the analogue to digital conversion on one (MAA 2300) and the de-emphasis and audio processing on the other (MAA 2400). As well as the basic

A-D the 2300 also features auxiliary inputs and a sophisticated switching mechanism. The switching allows the user to select between the two sets of inputs, to invert the phase of either and to insert de-emphasis as required.

In addition to the five chips already described there are a further two required to make the system run. Predictably there is a clock to time the whole system. This is an MEA 2600 IC. It has two clock outputs to provide a non-overlapping two phase clock signal for the IC set. Its frequency is set at four times the sub-carrier frequency, which for PAL systems is 17.7 MHz. However, this needs to be set up by external components, so it is quite possible to change frequencies in sets designed for other standards, like SECAM and NTSC.

The CCU

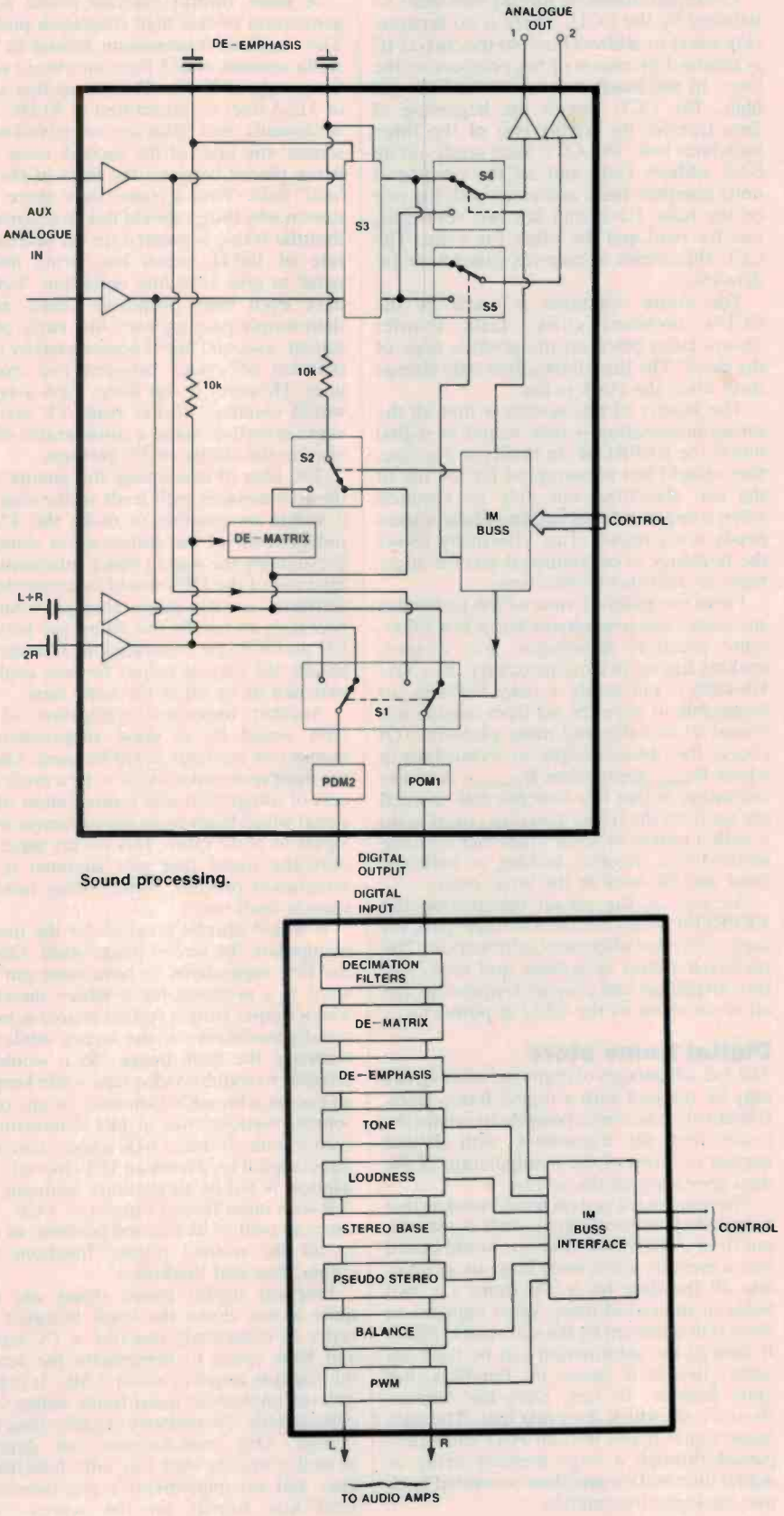
The final chip, and the one responsible for most of the practical advantages claimed for digital sets, is the central control unit. This consists of an 8048 core processor, three I/O ports, a clock and PLL circuit, some RAM and ROM and a few other bits and pieces.

The purpose of the CCU is to provide an interface to the infrared remote control, provide control of the tuner via the PLL, interface to the keyboard and the display, and last but not least, to directly control all the other chips in the set via the IM buss.

For the sake of clarity the IM buss has been left off the diagram. However, it connects to all the chips in the set. It also provides an interface to the outside world, most notably to an EEPROM which holds the tuning data for 29 channels and user controllable setting and alignment data. It also controls a videotext decoder.

The importance of the IM buss can best be illustrated by considering its operation during the life of the set. Before the set leaves the factory only two mechanical adjustments need to be made (to set up the horizontal output voltage and voltage on the picture tube). All the other adjustments are made with an 'electronic screwdriver'. It contains an 8039 processor that can interact directly with the set's 8049 via a plug on the IM buss. Control of the screwdriver is via a calculator style keypad.

Before alignment of the chassis can begin, the screwdriver must send out four 'transfer commands' which disable the supervisory functions of the processor and transfer control to the screwdriver. The technician now has direct access to host of familiar set-up parameters, like screen grid voltage, RGB cutoff, vertical and horizontal amplitude, position and linearity, plus all the usual raster geometry controls like picushion and trapezoidal adjustments. When alignment is finished the original four transfer commands are sent again. All the set-up information that has been transferred is now downloaded by the CCU into the EEPROM, where it will remain for the lifetime of the set, or until altered by further application of the screwdriver. ▶



Sound processing.

Communications on the IM buss must be initiated by the CCU. There is no separate chip select or address buss, so the correct IC is accessed by means of the protocol on the buss. In the inactive state all the lines are high. The CCU signals the beginning of data transfer by driving two of the three buss lines low. The CCU then sends out an 8-bit address code and all the peripheral units compare their addresses with the one on the buss. Each chip has two addresses, one for read and the other for write. The CCU then sends or receives either 8- or 16-data bits.

The entire operation is timed by the CCU's on-board clock. Data transfer always takes place on the positive edge of the clock. The lines themselves only change state when the clock is low.

The beauty of this system is that all the set-up information is now stored as digital bits in the EEPROM. In theory at any rate, they should last uncorrupted for the life of the set. Resetting will only be required when components fail and the whole system needs realignment. This effectively solves the tendency in conventional sets for alignment to drift slowly over time.

From the point of view of the technician the electronic screwdriver has a few other, quite practical advantages. For a start, sticking fingers in close proximity to a few kilovolts is inherently a risky business, so being able to align the set from outside it is bound to be safer and more pleasant. (Of course this doesn't apply to technicians in which R_{finger} approaches $R_{leather}$.) Another advantage is that it is now possible to align the set from the front. You don't need to do it with a mirror or some other cumbersome method that involves looking at both the front and the back of the set at once.

As well as the set-up information the EEPROM is also used as a storage space for user controlled alignment information. The preferred values of volume and tone, picture brightness and channel frequencies can all be accessed by the CCU at power up.

Digital frame store

The full advantages of digital processing can only be realised with a digital frame store. Effectively it becomes possible to isolate the screen from the transmitter, with all that implies in terms of the manipulation of the data appearing on the screen.

The way such a system would work is that a digitally processed signal, such as the output from a Digivision chip set, would be fed into a memory sufficiently large to accumulate all the data for a TV frame i.e: two fields of interlaced lines. What happens to them is determined by the software in place. If desired the information can be read out again, just as it comes in. Pointless, but quite feasible. In fact, Sony has demonstrated a set which does just that. The analogue signal is put into an A-D converter, passed through a large memory array as digital information and then converted back into analogue information.

A more fruitful exercise would be the generation of real high resolution pictures. The standard transmission format in Australia consists of 625 lines interlaced with a frame rate of 25 Hz. This means that a field of 312.5 lines is transmitted at 50 Hz. Conventionally, two fields are assembled on the screen; the lines of the second 'even' field being placed between the lines of the first 'odd' field. With a frame store there is no reason why things should not be so arranged that the frame is painted on the screen at a rate of 100 Hz, each line being painted twice to give 1250 line definition. Systems have even been proposed where, rather than simply painting each line twice on the screen, a second line is constructed by interpolation of values between two existing lines. However it was done, such a system would eliminate flicker from TV sets forever, as well as make a considerable difference to the clarity of TV pictures.

The idea of decoupling the picture from the transmission path leads to the idea that it would be possible to make the TV set independent of the transmission standard. Presumably the way in which information is read out of the DFS would be controlled by software, so only minor changes would be necessary to handle the difference between 525 and 625 line transmission. Decoders to handle the various colour formats could be switched on or off at the same time.

Another important application of the DFS would be in noise suppression. A number of methods could be used. One of the most common is likely to be a cyclic process of integration and reintegration of the signal which leads to an improvement in the signal to noise ratio. This occurs since it is only the signal that gets summed in the integration process. Noise, being random, cancels itself out.

It would also be possible for the user to manipulate the screen image itself. One of the first suggestions to have been put forward is a proposal for a screen insert, in which output from a second source is monitored somewhere on the screen while still receiving the main image. So it would be possible to watch a video tape while keeping an eye on a broadcast channel, or any other source. National has in fact demonstrated such a store. It uses a 64K screen store with direct digital feed from an ITT chip set. The window is fed by an auxiliary analogue circuit with input from a camera or VCR. The user can control its size and position, as well as all the normal picture functions like colour, hue and brightness.

Practical digital frame stores are still quite a way down the track however. In order to completely describe a TV screen and have space to manipulate the screen information requires about 2 Mb. It is possible to implement quasi-frame stores with considerably less memory capacity than this though. One manufacturer has demonstrated a system that can only hold three lines and yet implements a non-interlaced 1250 line format on the screen. The National set mentioned earlier creates an inset window with 64K. The noise reduction functions can be accomplished with less memory as well.

However, current thinking is that in order to implement all these functions at the same time, plus others that might come up, it is necessary to be able to manipulate the entire frame, and this requires considerably more memory than is practical given modern manufacturing and economic constraints. The problem is just one of size, cost and power. The biggest readily available memory chips on the market are 64K, so you need an awful lot of them to make up a DFS.

There are two schools of thought on future developments in this area. One holds that the future will belong to purpose built chips. Philips belongs to this camp, and has recently unveiled its first approximation to reality — a 308K charge couple device. These will go into production in 1985 and will cost about US$23. So to implement a real DFS would cost the manufacturer about $150. It's anyone's guess what it will cost the customer! Of course manufacturers can implement frame stores with much less memory as National has done.

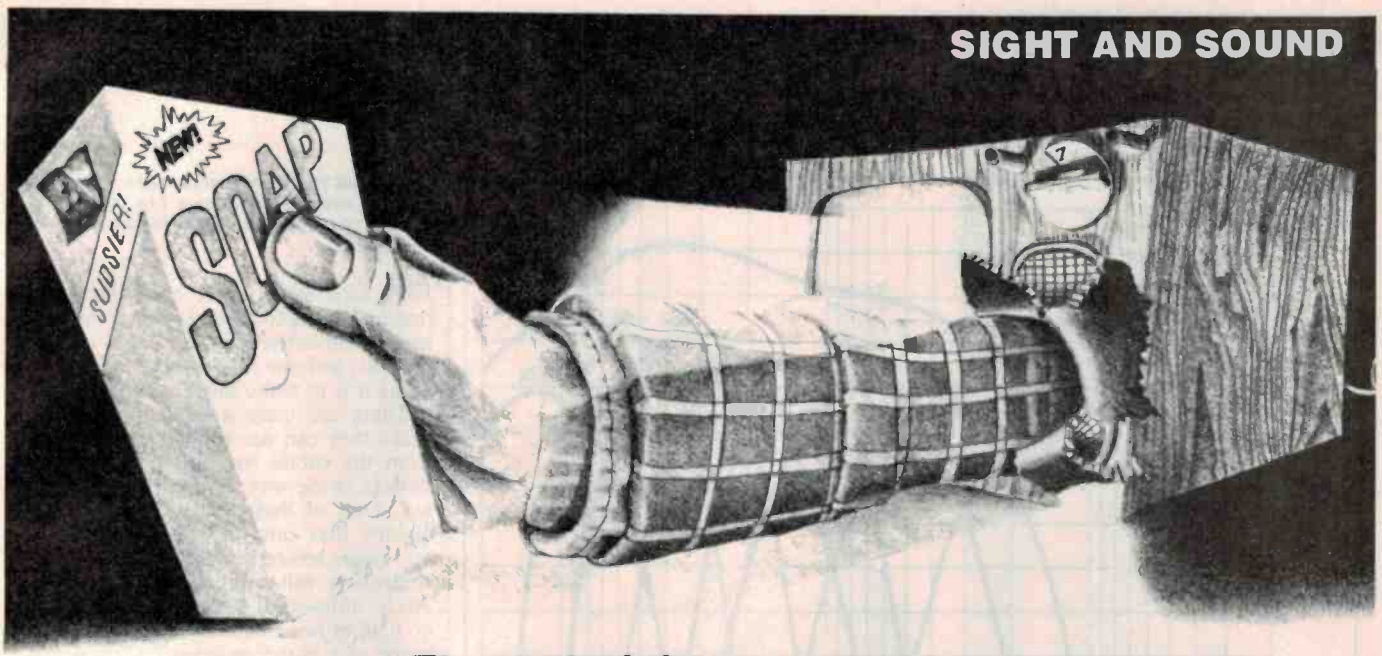
Most people in the industry believe Philips is barking up the wrong tree. The argument runs that future DFS will be composed of ordinary memory devices that will be available on the shelf at a reasonable price. Majority opinion has it that realistic devices will be available by about 1990. But plenty of pundits are advising against any collective holding of breath by TV designers. Developing a commercial 256K chip is proving a real problem so 1M is probably a way down the track, optimistic announcements from IBM notwithstanding.

Problems

So, what are the prospects for digital TV? There are Jeremiahs in every industry, and most of those in electronics are saying that digital TV is an idea way before its time. The argument runs that digital TV will not be viable from the point of view of the consumer until the introduction of a realistic DFS. Some gains are to be made in the areas of definition and resolution, but they are marginal, especially when compared to a top-of-the-line analogue set properly set up and viewed under optimum conditions.

At this point in time digitising offers no cost benefit to either manufacturer or consumer. In fact the converse is true. Digital sets are just about as expensive as they come, and with good reason too. The current generation of digital TV has been built only after considerable design effort and that does not come cheap. According to Motorola vice president, Arturo Kruger, digital TV represents nothing except "lower performance at much higher cost".

But this is not to say that digital TV is not the way of the future. When frame stores become available the consumer will certainly notice major improvements in clarity and in the way the set can be interfaced and manipulated. There will also be major reductions in price as economies of scale begin to take effect. In the long run VLSI will make itself felt, with attendant savings in manufacturing and servicing costs. ●

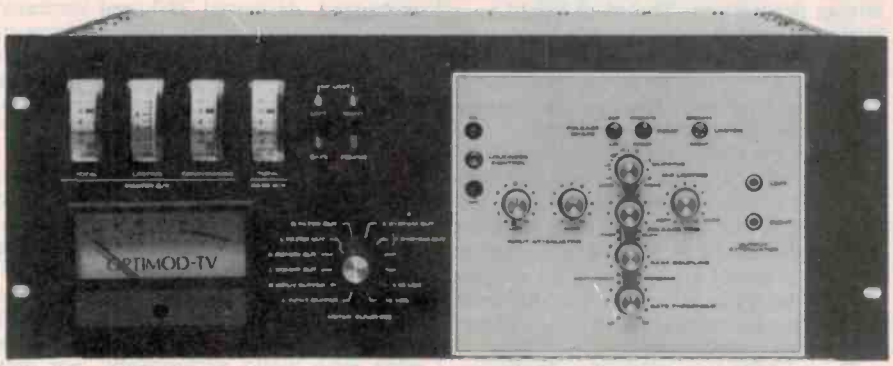


The end of the

SCREAMING ADVERTS

Raucous advertisements on radio and TV have proven extremely difficult to control, and some overseas agencies have given up the effort. Things are looking brighter in Australia with the introduction of new equipment.

Jon Fairall



Optimod TV: A TV audio processor now in common use in Australian TV stations. It has input conditioning filters, compressors, pre-emphasis and high frequency limiters, noise reduction and de-emphasis circuitry as well as loudness control functions.

THE US FEDERAL Communications Commission (FCC) recently decided to abandon its enquiry into loud commercials. According to statements from the Commission, its standing committee into commercial loudness had decided that the problems of loudness were so difficult to come to grips with that no legislative action was likely with existing technologies.

In Australia, the Federation of Commercial Television Stations (FACTS) has a working party that has been monitoring developments in measuring techniques. At present they are studying the implications of the US decision.

Difficulties

On the face of it, this seems a little queer, does it not? It can't be too difficult to tell how loud something is. As it turns out, it is *extremely* difficult to tell how loud something *seems*.

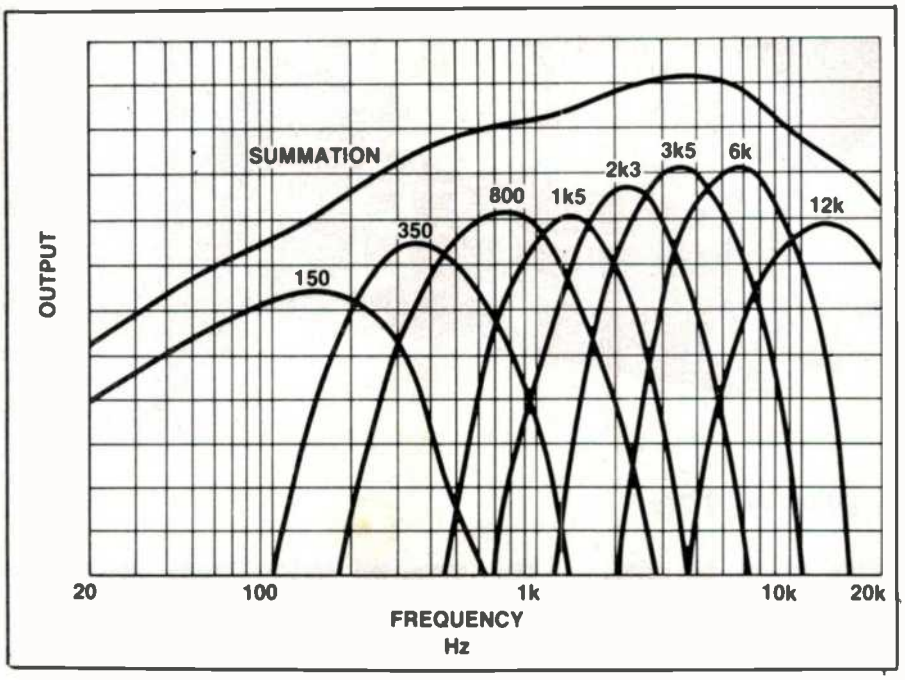
The first thing to understand is that there is a distinction to be made between loudness and volume. Volume is an objective phenomenon, readily measurable, that relates to the voltage excursions in the transmitter and the amplifier, the movement of the speaker and even the movement of air molecules between your ears and the speakers.

The question of how loud a particular bit of programme seems to the viewer is much more complex. To be sure it depends on volume as described above. But it depends on a whole host of subjective factors as well. The presence and level of other noise in the room, the contrast between a particular bit of programme and the bits that surround it and the actual content of the material all affect the way it seems to sound.

The human ear also has a non-linear response to frequency, so that some frequencies sound louder than others. Peak response is somewhere in the range 2-8 kHz and trails off to somewhere between 15 and 20 kHz. The exact figures vary from individual to individual, and for any individual they also vary over time. A typical healthy twelve-year-old can hear close to 20 kHz on average. By the time that same person has reached fifty, frequencies beyond 12 kHz will probably be beyond reach.

LLMs

All these factors taken together make it very difficult to put figures on 'acceptable' and 'unacceptable' sound levels. The FCC decision was the culmination of over a ▶



CBS's best fit: The frequency response of the CBS loudness indicator. Experience has shown that this reponse closely models the behaviour of the average human ear.

decade's frustrating work trying to build a machine that would accurately model human perceptions. The ideal would be a loudness level monitor (LLM) that could set levels as they were broadcast, and in so doing keep all programme material at the same perceived level. It would also prevent sudden changes in programme level.

In fact, the end result of US research was a machine that approximated this goal quite well. Not well enough for a litigious country like the US, where the goal was objective criteria that could be applied in a court of law, but certainly good enough for a country like Australia, where the goal has been to achieve self-regulation of the industry rather than outside control.

These LLMs are produced under licence to CBS by Orban in the US. The latest models divide the audio spectrum into eight bands, and then add the output of each band according to an algorithm that closely models the human perception of sound.

There is also provision to account for the response times of the hearing mechanism. CBS research showed that the ear acted rather like a filter with time constants of 20 ms for attack and 200 ms for decay. This is accurately reproduced in the instrument together with a summing function that has somewhat longer attack and decay times.

CBS ran a series of tests in 1982 with members of the public to see how well their perception of whether a commercial was louder than normal agreed with the LLM. Testing programmes were developed in which the subjects had to watch a twenty minute show consisting of fifteen commercials intermixed with news programmes. Subjects operated a volume control in an attempt to keep all programmes at the same level.

The controller left 60% of commercials unchanged, decreased 27% and increased 13%. The subjects left 50% unchanged, decreased 35% and increased 15%. The difference between 50% and 60% is probably the result of imperfections in the equipment, and subjective factors that affect perception but not the equipment.

The results of the use of loudness controllers was impressive enough for a number of Australian TV stations to start using them. As a result, it is now quite common to find that the audio level of material being broadcast is set quite automatically as it goes to air. According to the Senior Audio Director of TCN 9, Ray Derreck, this results in far more even audio performance, not only because the machine is better at discerning levels than an operator but because human operators find the exercise of setting levels all day so boring they are inclined to get a bit sloppy towards the end of a shift.

New-generation controllers have the ability to change the level of the incoming signal so that all programme material is at the same level while at the same time holding the output level below a preset level so as to prevent overmodulation of the signal. It is also possible to tie them into the programming computers that control the station output such that they are defeated during entertainment programmes. This prevents the controller destroying special audio effects that may be used for dramatic impact during a film.

The tricks

However, anyone who listens to the commercial channels will realise the FCC does have a point in suggesting the exercise is not 100% reliable. It is one of the facts of life that makers of commercials want their commercial advertisements to stand out from the rest, and one time-honoured method of doing it is to make them louder.

There are quite a number of technical tricks they can use to do this, quite apart from the subtle (or unsubtle) production devices in the way the commercial is scripted. One of these is to introduce a frequency bias into the audio towards the mid-range where hearing is best. Loudness controllers will compensate a lot for this effect, although it is still helped if there are no high or low frequency distractions to get in the way of the message.

Another one is to compress the audio in the final mix of the commercial. Compression is a technique by which the dynamic range of the programme is reduced, that is, the loudest sounds are reduced in level and the softest are increased. Since TV audio has a limited dynamic range when compared to other audio systems it is a common practice when mixing audio signals for TV. Commercial makers though, tend to compress the signals more than necessary.

The trick is that the broadcaster sets up the signal with respect to the maximum peaks in the programme material. The object of the exercise, after all, is to generate the most powerful signals possible consistent with the modulation level permitted by legislation and the equipment. Overmodulation, of course, distorts the signal, and is something that a broadcaster avoids at all costs.

If an overcompressed signal is broadcast, its maximum excusions will be at the same level as the rest of the material, but the minima will be at a greater level, as indeed, will the average level of the signal.

A number of factors prevent the overuse of this technique. The most powerful is that compression introduces a distortion into the system, and this sets a limit on how much it can be used. It also means it's more useful for speech than music where the requirements of linear response are much greater.

The other even more pragmatic reason is that broadcasters don't like it because it turns viewers off. Both FACTS and the Australian Broadcasting Tribunal report that the number of complaints from the public have started to decline in the face of the new engineering practices. FACTS itself takes quite a strong line on loudness, and in the past has returned a number of commercials to their makers for remixing.

The situation is quite different in the US, where the FCC is still receiving many thousands of complaints a year about noisy commercials. It seems little is to be done in the near future, in the US at least. Maybe the final answer for 'screamers' is a remote control to turn the audio down, or off. ●

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7446	.70	.65	.60
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74LS74	.45	.40	.35
74LS86	.45	.40	.35
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ICL7663	4 90
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ICM7218A	18 50
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ICM7226A	48 50
ICM7227A	19 95
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ICM7240	7 50
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ICM7555	2 75
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74 S

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74S86	1 60
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74C195	2.00
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74C221	2.75
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74LS

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74LS03	40
74LS04	60
74LS05	60
74LS08	40
74LS09	80
74LS10	60
74LS11	80
74LS12	80
74LS13	90
74LS14	80
74LS15	80
74LS19	90
74LS20	50
74LS21	90
74LS22	90
74LS24	90
74LS26	90
74LS27	90
74LS28	90
74LS30	40
74LS32	40
74LS33	70
74LS37	70
74LS38	80
74LS40	80
74LS42	60
74LS47	1.00
74LS48	1.00
74LS49	1.80
74LS51	70
74LS54	80
74LS55	80
74LS63	2.80
74LS73	60
74LS74	60
74LS75	60
74LS76	1 00
74LS77	1 00
74LS78	1.10
74LS83	70
74LS85	60
74LS86	80
74LS90	60
74LS91	60
74LS92	60
74LS93	70
74LS95	1.20
74LS96	1.20
74LS107	90
74LS109	90
74LS112	70
74LS113	70
74LS114	80
74LS122	1 30
74LS123	90
74LS125	80
74LS126	1 20
74LS132	1 50
74LS133	4 90
74LS136	1 50
74LS138	80
74LS139	80
74LS145	2 10
74LS147	2.50
74LS148	1 90
74LS151	1 20
74LS152	1.95
74LS153	1 00
74LS154	2 95
74LS155	1.00
74LS156	1.50
74LS157	1.10
74LS158	1 00
74LS160	1 00
74LS161	80
74LS162	1 50
74LS163	1 10
74LS164	90
74LS165	1 00
74LS166	2 55
74LS169	2 45
74LS173	90
74LS174	90
74LS175	80
74LS181	4 00
74LS190	1 50
74LS191	1 20
74LS192	1 20
74LS193	1 20
74LS194	1 20
74LS195	90
74LS196	90
74LS197	1 75
74LS221	2 00
74LS240	1 90
74LS241	1 90
74LS242	1 90
74LS243	1 90
74LS244	1 50
74LS245	2.60
74LS247	1.30
74LS248	1.50
74LS249	1.50
74LS251	1.50
74LS253	1.20
74LS257	70
74LS258	1.20
74LS259	1.50
74LS261	2.50
74LS266	1.20
74LS273	1.95
74LS275	6.80
74LS279	60
74LS280	2.60
74LS283	1.50
74LS290	1.50
74LS293	1.30
74LS295	1.75
74LS297	6.50
74LS298	1.20
74LS299	3.90
74LS320	3.95
74LS321	3.95
74LS322	6.75
74LS323	6.50
74LS324	2.20
74LS326	2.20
74LS327	2.20
74LS352	2.20
74LS353	2.20
74LS354	3.95
74LS365	1.00
74LS366	1.00
74LS367	1.00
74LS368	1.00
74LS373	1.90
74LS374	1.90
74LS375	1.00
74LS377	2 15
74LS378	1.20
74LS379	1 90
74LS386	1.00
74LS390	1.80
74LS393	1.80
74LS395	2 00
74LS396	2 50
74LS398	3.00
74LS399	1 90
74LS424	5.50
74LS440	5.50
74LS441	5.50
74LS442	5.50
74LS443	5.50
74LS445	2.20
74LS446	5.50
74LS447	1 90
74LS448	5.50
74LS449	5.50
74LS490	3 20
74LS540	5.95
74LS541	3.95
74LS621	2.75
74LS622	2.75
74LS623	5.95
74LS629	5.95
74LS640	3.95
74LS641	2.75
74LS642	2.75
74LS643	2.75
74LS644	2.75
74LS645	2.75
74LS668	1.75
74LS669	1.75
74LS670	2.75
74LS673	12.55
74LS674	12.55
74LS690	3.95
74LS691	3.95
74LS692	3.95
74LS693	3.95
74LS696	3.95
74LS699	3.95

CDP

CDP1802	10 50
CDP1864	17.50

CPU

6502	13.00
6502A	14.00
6503	13.00
6504	13.00
6505	13.00
6507	13.00
6520	5 50
6521	5.90
6522	13.00
6522A	13.00
6532	14.00
6545	19.50
6551	12 90
2650	21.00
2651	23.00
6800	6.00
6802	7.00
6808	12.50
6809	10.00
6810	3.50
68B10	7.50
6820	5.50
6821	5.50
68B21	7.50
6840	6 50
6844	12.80
6845	12.50
6847	3.50
6850	7.90
68B50	10.00
6860	19.50
6875	15.00
Z80CPU	5.00
Z80ACPU	6.00
Z80BCPU	12 00
Z80P10	4.50
Z80AP10	6.50
Z80CTC	5.50
Z80ACTC	6.50
Z80DMA	16.00
Z80ADMA	19.00
Z80AS10	15.00
Z80S10	13 00
AD570	69.50
AD590	9.50
AD7524	17 50
AY-3-8910	14 50
AY-3-2513	14 50
MSM5832	16 50
MM58174	19 50
MM5303	7.50
MM5309	14 50
MM5369	4.95
LH0002	9 50
LH0042CH	9 50
LH0070	9 50
LH0071	9.50
TL061	1 50
TL062	2 90
TL064	4.90
TL071	1 20
TL072	2 90
TL073	3 20
TL074	4 90
TL081	1 90
TL082	2 50
TL083	2 90
TL084	3 45
TL494	4 90
TCA220	9 50
TCA280	4 50
TDA1024	2 90
TA7205P	3 90
TEA1002	17 50
UAA170	5 95
UAA180	3 75
LM10CH	7.50
LM301	50
LM301H	1 50
LM302H	6 50
LM305H	1 50
LM307CN	1 00
LM307H	1.60
LM308	1.00
LM308H	1 80
LM309K	1 90
LM310N	3 20
LM310H	3 20
LM311	1 00
LM311H	1 80
LM317T	2 50
LM317K	4.50
LM318	4.90
LM319	4 90
LM324	1 00
LM325	4 50
LM326	4 50
LM329DZ	90
LM344Z	1.90
LM335Z	2 20
LM336 2 5V	2 95
LM338K	12 50
LM339	1 20
LM348	1 80
LM349	1 60
LM350K	8 50
LM351N	1 00
LM353	2 50
LM356N	2 40
LM357	2.40
LM358	1 40
LM361	3 50
LM377	4 90
LM378	3.95
LM380 8PIN	1 80
LM380 14PIN	1 90
LM381	3.50
LM382	3.50
LM383	3.90
LM384	3.50
LM386	1 95
LM387A	3 95
LM387	2.00
LM390	2 95
LM391	2 90
LM393	1 00
LM394	4.95
LM395T	9.95
LM396K	22.50
LF398	5.90
NE544	6.50
NE555	40
NE556	1.20
NE558	5.00
NE560	4.60
NE561	4.60
NE565	1.60
NE566	2 90
NE567	2 00
NE570	5.90
NE571	5.90
NE592	6 90
NE594	9.50
LM709-14	1 50
UA710CN	1.00
LM711	1 20
LM723	75
LM723CH	1 50
LM725	4 75
LM733	1 50
UA739	2 75
741	40
UA747	1 30
UA748	1 00
MC1310	9 50
MC1312	7 95
MC1314	7 95
MC1315	8 95
MC1327	7 95
MC1350	1 95
MC1408L8	7 50
MC1437	4 95
MC1445	5 95
MC1456	1 95
MC1458	1 20
MC1456L	14 50
MC1469R	6 90
MC1488	1.20
MC1489	1 20
MC1494	8 40
MC1495	8.90
MC1496	2 50
LM1596	3.00
MC1648	8 90
LM1812	10 50
LM1830	3 90
LM2907	3.90
LM2917 8PIN	4.90
LM2917 14PIN	4.90
MN3001	17 50
CA3028	2 00
CA3046	1 90
CA3056	6.50
CA3059	5 95
CA3080	1.90
CA3086	1.90
CA3089	3.90
CA3100E	7 95
CA3130E	2 20
CA3130T	2 95
CA3140E	2 20
CA3140T	2 95
CA3240E	11 95
LM3401	1 00
LM3900	1 20
LM3905	1 75
LM3909	2 95
LM3911	2 95
LM3914	5 90
LM3915	5 90
LM3916	5 90
LM3999Z	2 60
RL4136	1 95
RC4145	20 90
RC4194	3.90
MM 5369	4.95

SCR & TRIACS

SC141D	1 90
SC141E	1.95
SC142E	2 95
SC146D	2 85
SC146M	2.95
SC150D	4 95
SC151D	2 95
C103YY	90
C103B	90
C106B	90
C106D	90
C122D	2 50
C122E	2 95
C260D	8.50
C260E	9 90
2N2646	1.20
2N2647	2 50
2N6027	90

TRANS.

AC125	1 20
AC126	1 20
AC127	1 20
AC128	1 20
AC187	1 50
AC188	1 50
AC149	3 40
AD161	2 90
AD162	2 90
AF118	2 90
AF126	2 90
AF127	1 50
BC 107	50
BC 108	50
BC 109	50
BC 159	50
BC 177	60
BC 178	60
BC 179	60
BC 182L	40
BC 212	30
BC 318	30
BC 320	40
BC 327	30
BC 328	30
BC 337	40
BC 338	40
BC 546	40
BC 547	20
BC 548	20
BC 549	20
BC 550	40
BC 556	40
BC 557	20
BC 558	20
BC 559	20
BC 639	50
BC 640	50
BC Y70	1 90
BC Y71	1 90
BD135	1 00
BD136	90
BD137	90
BD138	90
BD139	90
BD140	60
BD201	90
BD202	90
BD232	90
BD233	90
BS235	90
BD236	90
BD237	90
BD238	90
BD262	1.20
BD263	1 20
BD437	1 50
BD488	1 50
BD647	1 80
BD648	1 80
BD677	1 80
BD681	2 00
BD682	2 00
BDV64B	3 90
BDV65B	3.90
BDX63	6.50
Y96 (BUX 80)	4.90
BDY97 (BUX 80)	4 90
BF115	1 50
BF167	1 20
BF173	1 20
BF177	1 20
BF180	1 20
BF182	90
BF183	60
BF184	60
BF198	60
BF199	60
BF200	1 20
BF245	1 50
BF337	1 50
BF338	1 90
BF458	1 00
BF459	1 00
BF469	1 20
BF470	1 20
BF494	90
BF495	90
BFW10	1 50
BFW11	1 50
BFW16	1 50
BFY50	1 20
BFY90	1 90
BFX90	1 50
BU126	2 50
BU208	4 90
BUX80	3 90
BUX80	4 90
MFE131	2 95
MFE3001	9 95
MFE3003	6 95
MJ413	5 90
MJ802	7 50
MJ901	4 50
MJ1001	3 90
MJ11011	9 90
MJ11015	14 50
MJ11016	14 50
MJ15003	6 50
MJ15004	6 50
MJ15024	10 00
MJ2501	8 90
MJ2955	1 50
MJ3001	6 90
MJ4032	12 50
MJ4035	11 90
MJ4502	6 90
MJE340	2 00
MJE350	2 50
MJE371	2 90
MJE521	2 50
MJE700	3.50
MJE800	2.90
MJE2801	3.95
MJE2955	4.90
MJE3055	3.90
MJE13005	5.90
MJE13007	7 90
MJE13009	12 50
MPF121	2 50
MPF131	2 50
MPSA05	1 00
MPSA06	1 00
MPSA10	1 00
MPSA12	1 00
MPSA13	1.00
MPSA14	1 00
MPSA20	1.00
MPSA42	1 00
MPSA43	1 20
MPSA55	1 00
MPSA56	1 00
MPSA63	1 00
MPSA65	1 00
MPSA92	1 00
MPSA93	1 20
MPF102	90
MPF103	90
MPF105	90
MPF106	90
MPF109	90
MPSL01	1 50
MPSL51	1.50
MPSU02	1 75
MPSU52	1 90
MPSU56	1.75
MPU131	1.75
MRF221	19.50
MRF237	5 90
MRF238	29 50
MRF245	53 50
MRF421	53 50
MRF454	52 50
MRF455	37 00
MRF455	37 00
MRF475	7 70
MRF603	19 50
MRF641	49.00
MRF646	53 00
MRF901	3.75
MPF131	1.90
TIP31A	70
TIP31B	70
TIP31C	75
TIP32A	70
TIP32B	70
TIP32C	75
TIP41A	1.40
TIP41C	1.50
TIP42A	1.40
TIP42C	1 50
TIP49	1 90
TIP50	2 20
TIP53	2 50
TIP[illegible]	1 50
TIP[illegible]	1 50
TIP[illegible]	1 50
TIP[illegible]	1 50
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145	3 40
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TIP3055	1 50
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2N697	1 00
2N918	1 00
2N1304	1 00
2N1613	1 20
2N2102	1 90
2N2219	90
2N2222A	1.00
2N2369	1 00
2N2484	1 00
2N2646	1 20
2N2647	2 50
2N2894	1 00

2N2904	1 10
2N2905	1 10
2N2906	1 10
2N2907	1 10
2N3019	1 90
2N3053	90
2N3054	1 90
2N3055	1 00
2N3096	1 20
2N3109	1 90
2N3251	1 90
2N3302	1 90
2N3440	1 80
2N3441	2 90
2N3442	3 50
2N3563	30
2N3564	30
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2N3640	30
2N3641	30
2N3642	30
2N3643	30
2N3644	30
2N3645	30
2N3646	30
2N3702	1 20
2N3704	1 40
2N3739	4 50
2N3771	5 50
2N3772	5 70
2N3773	5 90
2N3792	6 00
2N3819	1 20
2N3866	2 95
2N3904	1 00
2N3906	1 00
2N4030	1 50
2N4032	2 20
2N4033	2 20
2N4036	2 50
2N4121	1.50
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2N4248	40
2N4249	40
2N4250	40
2N4258	50
2N4355	50
2N4356	50
2N4360	1 00
2N4401	30
2N4402	30
2N4403	30
2N4416	1.90
2N4427	2 90
2N4919	2.90
2N5088	1 00
2N5089	1 00
2N5139	1 20
2N5179	1 20
2N5190	2 50
2N5191	3 30
2N5192	3 10
2N5193	2.50
2N5194	2 95
2N5195	3 30
2N5210	1 50
2N5245	1 50
2N5303	8 50
2N5401	1 50
2N5457	1 00
2N5458	90
2N5459	90
2N5461	90
2N5462	90
2N5485	90
2N5486	90
2N5489	14 50
2N5590	16 50
2N5591	18 50
2N5641	19 50
2N5656	2 50
2N5770	30
2N5777	1 50
2N5830	30
2N5831	30
2N5873	1 40
2N5874	1 70
2N5944	15 50
2N5945	18 50
2N5946	19 50
2N5961	1 90
2N6027	1 00
2N6049	1 90
2N6080	18.50
2N6083	21.90
2N6084	32 50
2N6124	1 90
2N6125	1 90
2N6130	1 90
2N6133	1 90
2N6256	14 50
2N6259	13 50
2N6274	29.50
2N6378	4.90
2N6425	4.50
2N6578	5.90
3N201	1 50
2SA683	2 95
2SC2028	3 95
2SC2029	3 95
2SC2166	4 95
2SC1730	1 95
2SC1969	6 30
2SC1973	3 95
VN88AF	3 95
2SC372	1 95
2SC495	2 95
2SC710D	1 95

2SC735	1 95
2SC900F	1 95
2SC945A	1 95
2SC1014	2 50
2SC1017	4 95
2SC1018	4 95
2SC1061	2 95
2SC1096	2 95
2SC1173	2 95
2SC1226	2.95
2SC1306	6.30
2SC1419	2 95
2SC1449	1.95
2SC1674	1 95
2SC1675	1.95
2SC1307	6.90
2SD288	3 95
2SD325	2 95
2SD525	3 95
2SK45	3 95
2SJ49	6 00
2SJ56	12 50
2SK45	3 95
2SK134	6 00
2SK176	12.50
1N4001	10
1N4002	15
1N4007	20
1N5400	40
1N5404	30
1N5408	40
OA47	80
OA90	50
OA91	50
OA95	50
5082-2800	2 95
5082-2811	4 95
HLMP6620	5 95

BRIDGES

1.5AMP

W005	50
W02	40
W04	50

6AMP

BPC602	2 90
KBPC604	3 50
KBPC608	4 50

10AMP

KBPC10005	3 90
KBPC1002	4 20
KBPC1004	4 90

35AMP

KBPC3502	5 90
KBPC35014	MD
A3504	6 90
KBPC3510	MDA
3510	9 90

74

7400	45
7401	45
7402	45
7403	45
7404	60
7405	80
7406	80
7407	80
7408	60
7409	60
7410	60
7411	70
7412	70
7413	70
7414	80
7415	70
7416	80
7417	80
7420	60
7421	80
7422	80
7423	90
7425	90
7426	70
7427	80
7428	80
7430	70
7432	70
7433	70
7437	80
7438	90
7439	90
7440	90
7442	90
7443	1.60
7444	1.50
7445	1.00
7446	1.20
7447	1.50
7448	1 20
7449	1 20
7450	90
7451	90
7452	80
7453	70
7454	80
7455	90
7460	70
7461	90
7462	1 00
7463	1.20
7470	80
7472	90
7473	90
7474	70
7475	70
7476	80
7477	1.20
7478	1.20
7480	1.20
7482	1 80
7483	1 10
7485	1 20
7486	1 20

7489	3 90
7490	1 00
7491	1 00
7492	1 00
7493	1 00
7494	1 50
7495	1 00
7496	1 50
7497	2 30
74100	1 65
74107	1 20
74109	90
74110	1 50
74111	1 50
74112	1.50
74113	1 50
74114	1 50
74120	1 95
74121	90
74122	90
74123	1.50
74125	1.00
74126	1 00
74128	1 80
74132	1 00
74136	1.00
74138	1 80
74139	1 50
74141	1 10
74142	1 45
74143	1 45
74144	3 90
74145	1 45
74147	1 95
74148	2 00
74150	1 50
74151	1 20
74154	1.75
74155	1.20
74156	1.70
74157	1.00
74158	1.00
74160	1.00
74161	1.20
74162	1.20
74163	1.40
74164	1.20
74165	1.20
74166	1.70
74167	2.20
74174	1 45
74175	1.20
74176	1.40
74177	1 40
74178	2 15
74179	2.15
74180	1.20
74182	1.20
74184	1.20
74190	1.00
74191	1 45
74192	1 65
74193	80
74194	1 10
74195	1 00
74196	1.20
74197	1 10
74198	1 10
74199	1.30
74221	1.90
74240	2 90
74241	2 90
74242	2 40
74243	1 90
74244	1 90
74245	2 40
74246	2 25
74247	2 25
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74253	1 10
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74276	2 45
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74283	2 45
74289	3 25
74290	90
74293	90
74295	1 65
74298	2 45
74299	1 75
74351	1 85
74352	1 85
74365	1.50
74366	1.50
74367	1 50
74368	1 50
74373	2 25
74374	2 25
74375	1 75
74377	2 45
74390	1 95
74393	1 95
74425	2 55
74226	2 55
74490	2 65
75107	2 50
75110	2 50
75150	2 50
75154	2 50
75450	1 50
75451	90
75452	90
75453	90
75461	1 50
75462	1 50
75471	3 00
75472	3 00
75491	2 00

75492	2 00
75493	3 00
75494	3 00
8121	5.00
8123	4 00
8130	6 95
8131	6 95
8135	6 95
8136	6 95
8303	5 50
8304	6 95
82S23	5 95
82S123	6 95
8311	5 95
8641	5 95
8820	6 95
8830	6 95
8831	6 95
8832	6 95
8833	6 95
8834	6 95
8835	5 95
8836	3 75
1488	1.00
1489	1.00
81LS95	3.75
81LS96	3.75
81LS97	3.75
81LS98	3.75
8T26	3 00
8T28	3 00
8T30	3 00
8196	1 80
8197	1 80
8T13	2 95
8T14	2 95
8080	8 00
8085	9.50
8086	59 00
8088	29 00
8155	6 50
8156	11 50
8185	37 50
8202	52 50
8203	69.50
8206	115.50
8212	2.90
8214	4.90
8216	2.90
8224	3.50
8226	4 90
8228	5 50
8231	199 00
8232	199 00
8237	39 00
8238	9 50
8243	8 50
8251	4 90
8253	7 50
8255	5 50
8257	16 50
8259	6 50
8274	89 00
8272	33 00
8273	65 00
8274	42 50
8275	38 50
8276	28 50
8279	8 50
8282	6 90
8283	6 50
8284	8 50
8286	6 50
8287	6 50
8288	25 00
8289	73 00
8291	43 00
8292	34 50
8293-10	26 50
8741	57 50
8748	65.00
8749	58 50
8755	33 50
8035	6 90
8039	7 90
FD1771	19 00
FD1791 (8876)	39 00
FD1793 (8877)	39 00
FD1795	39 00
FD1797	39 00
WD1691	29 50
WD2143	14 50
WD1931	22 50
WD1933	34 00
WD1983	14 75
WD1993	59 00
WD2123	26 50
WD8250	16 50
TR1602 (S1883)	8 50
TR1863	8 90
COM8116	24 00
BR1941	23 00
CRT8002A	59 90

74F SERIES

74F00	79
74F02	79
74F04	92
74F08	79
74F10	79
74F11	79
74F20	79
74F32	79
74F64	79
74F74	89
74F86	1 19
74F109	99
74F138	1 79
74F139	1 79
74F151	1 79
74F153	1 79

74F157	1 79
74F158	1 79
74F175	2 78
74F181	5 98
74F182	2 73
74F189	7 44
74F190	4 86
74F191	4 86
74F194	2 41
74F241	3 72
74F243	4 34
74F244	3 72
74F251	1 93
74F253	1 93
74F257	1 93
74F258	1 93
74F350	4.34
74F352	1 93
74F353	1 93
74F373	4.84
74F374	4.84
74F399	2.78
74F521	4 22
74F533	4.84
74F534	4 84

MEMORY

2101	6 90
2102	2 50
2112	7 90
2114	2 95
2708	8.90
2716	6.90
2732	8 00
2764	12 00
27128	49 00
4116	3 95
4164	8 00
6116	8 00
6264	59 00
58725 (6116)	7 00
2101 (5101)	7 90
(8101)	7 90
5101	7 90
8101	7 90
2532	12 50

OPTO

4N25	1.20
4N26	1.20
4N27	1.20
4N28	1.20
4N29	1 50
4N30	1 60
4N32	1 50
4N33	1 50
4N35	1 50
4N37	1.50
MCT6	2 50
MCT66	6 90
MCT2	1 50
TLD 74	5 90
TLQ 74	6 50
FND357	1 80
FND500	1 80
FND507	1 80
FND800	2 50
TIL31A	2 95
TIL81A	2 95
TIL306	14 50
MAN72 (DL702, 2	3 50
MAN74 (DL704)	3 50
BPW50	2 25
HP5082-2811	4 95
HLMP 6620	3 95
COY89	1 50
MOC3011	2 95
MOC3020	2 50
MOC3021	2 95
LEDS	
3mm RED	25
3mm YELLOW	30
3mm GREEN	30
5mm RED	15
5mm YELLOW	30
5mm GREEN	30
5mm ORANGE	30
RED RECT	30
GREEN RECT	30
YELLOW RECT	30
RED CHROME BEZEL	1 20
YELLOW CHROME BEZEL	1 20
GREEN CHROME BEZEL	1 20

VOLTAGE REGS

78050C	80
7805KC	2 50
7812UC	1 20
7812KC	2 50
7815UC	1 20
7815KC	2 50
7818UC	1 20
7818KC	2 50
7824UC	1 20
7824KC	2 50
7905UC	1 90
7905KC	3 00
7912UC	1 90
7912KC	3 00
7915UC	1 90
7915KC	3 00
7918UC	1 90
7924UC	1 90
78L 05	50

78L12	50
78L 15	75
78L 18	75
78L 24	75
79L 05	1 20
79L 12	1 20
79L 15	1 20
79L 18	1 20
79L 24	1 20
LM309K	
(7805KC)	1 90
LM317	2 50
LM317K	4 50
LM317HV	9 50
LM323K	6 50
LM337T	2 90
LM337K	6 50
LM338K	9 50
LM350T	6 50
LM350K	7 50
LM395K	22 50
LM396K	19 50
78H 05KC	9 00
78H 12KC	9 00
78HGKC	9 50
78P 05KC	16.50
79HGKC	16 50
78S 40	3 50
MC1496L	14 50

SPECIAL FUNCTION

LM 4250	2 45
NE5534 N	2 50
NE5534 AN	2 95
MC3340	1 90
MC3341	2 90
76477	8 95
76488	8 95
76489	9 95
8038	6 50
OM335	22 50
OM350	10 50

XR2206	7 95
XR2207	7 95
XR2208	6 90
XR2209	6 90
XR2211	7 45
XR2216	5 90
XR2240	6 95
XR2243	7 95
XR8038	7 50
ICC7660	12 50
95H90	8 50
11C90	16 50
LM7555	1 90
LM7556	3 50
MC10116L	1 50
LM13600	3 95
LF13741	80
LF13741-H	1 50
DS75451	60
DS75452	60
DS75491	2 00
DS75492	2 00
DM2502	12 50
ADC080	16 00
ADC808	17 00
DAC0800	4 50
DAC0808	4 50
SAK140	9 50
ZN414	1 95
UA170	5 95
4000	3 35
4001	3 35
4002	50
4006	1 90
4007	40
4008	1 20
4009	90
4010	90
4011	40
4012	40
4013	60
4014	1 90
4015	1.90
4016	75
4017	1 50
4018	1 90
4019	80
4020	1.50
4021	1.50
4022	1.50
4023	75
4024	1 20
4025	80
4026	2 40
4027	1 20
4028	1 20
4029	1 50
4030	1 50
4031	2 95
4032	2 75
4033	2 75
4034	3 50
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4042	1 00
4043	1 60
4044	1 20
4045	4 90
4046	2 50

4047	1 20
4048	1 20
4049	1 00
4050	1 00
4051	1 50
4052	1 50
4053	1 50
4054	3 90
4055	3 90
4056	4 20
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4063	2 00
4066	2 50
4067	9 90
4068	1 00
4069	1 00
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4071	40
4072	90
4073	90
4075	90
4076	1 50
4077	80
4078	80
4081	40
4082	80
4085	2 20
4086	2 30
4089	3 50
4093	75
4094	3 35
4095	2 40
4096	2 40
4097	6 50
4098	2 90
4099	3 90
4104	6 90
4160	1 25
4161	1 25
4162	1 25
4163	1 25
4174	1 25
4175	1 60
4194	1 95
4402	1 00
4404	1 15
4408	6 90
4409	13 50
4410	11 50
4411	12 60
4412	5 45
4415	10 15
4416	5 60
4419	3 45
4422	9 50
4426	2 35
4428	1 75
4433	2 75
MC14433	13 90
4435	7 95
4441	1 50
4443	3 90
4445	2 65
4446	3 55
4449	1 00
4450	3 75
4451	3 75
4457	5 90
4458	9 90
4469	14 90
4490	5 90
4495	3 95
4500	8 90
4501	50
4502	1 80
4503	90
4504	2 00
4506	75
4507	40
4508	4 50
4510	1 50
4511	1.00
4512	1.10
4513	2.65
4514	2.90
4515	2 90
4516	1 45
4517	8 75
4518	2 50
4519	1 90
4520	1.20
4521	3 90
4522	1 90
4526	1 85
4527	2 65
4528	1 15
4529	1 80
4530	1 60
4531	1 65
4532	2 65
4534	8 90
4536	6 50
4538	3 50
4539	1 65
4541	1 60
4543	2 50
4544	10 50
4549	7 25
4551	1 80
4553	5 50
4554	2 35
4555	1 10
4556	1 25
4557	7 85
4558	2 25
4559	7 25
4560	3 75
4561	1 80
4562	8 45
4566	3 00
4568	4 25
4569	2 50
4572	75
4580	8 95
4581	3 10
4582	2 25
4583	1 65
4584	85
4585	2 10
4597	
4599	3 45
45104	7 25
45106	7 85
45107	7 25
45109	7 25
45112	7 85
SC1520	6 90
OM335	18.50

ANALOG/DIGITAL

ADC0800LCN	22 50
ADC0801LCN	23 95
ADC0803LCN	7 50
ADC0804LCN	6 50
ADC0808LCN	14 95
DAC1220LCN	14 95
DAC1020LCN	13 95
DAC0832LCN	5 50

NEW IC

74LS169	2 50
A7-3-1050	12 50
WD2791	59 00
WD2793	59 00
WD2795	59 00
WD2797	59 00

NEW ICS

LM11CN	2 95
LM1871	5.95
LM1872	5.95
280ADART	13 50

CRYSTALS

Y11000	1MHz crystals	11.50 9.50
Y11003	1.832MHz crystal	7 50 7 50
Y11005	2MHz crystal	6 90 6 90
Y11007	2.3040MHz crystal	6 50 6 50
Y11008	2.4576MHz crystal	6 50 6 50
Y11009	2.7648MHz crystal	4 90 4 90
Y11010	3MHz crystal	4 90 4 90
Y11015	3.5795MHz crystal	3 00 3 00
Y11018	3.93216MHz crystal	4 90 4 90
Y11020	4MHz crystal	4 90 4 90
Y11022	4.194304MHz crystal	3 90 3 90
Y11023	4.433618MHz crystal	4 90 4 90
Y11024	4.44MHz crystal	4 90 4 90
Y11025	4.75MHz crystal	4 90 4 90
Y11026	4.915200MHz crystal	6 90 6 00
Y11027	4.9562MHz crystal	4 90 4 90
Y11030	5.00MHz crystal	4 90 4 90
Y11033	5.0688MHz crystal	4 90 4 90
Y11040	6MHz crystal	4 90 4 90
Y11042	6.14MHz crystal	4 90 4 90
Y11045	6.6670MHz crystal	4 90 4 90
Y11050	8MHz crystal	4 90 4 90
Y11055	8.867238MHz crystal	4 90 4 90
Y11060	10MHz crystal	4 90 4 90
Y11061	10.6445MHz crystal	4 90 4 90
Y11065	11MHz crystal	4 90 4 90
Y11070	12MHz crystal	4 90 4 90
Y11072	14.31818MHz crystal	4 90 4 90
Y11075	15MHz crystal	4 90 4 90
Y11080	16MHz crystal	4 90 4 90
Y11082	18MHz crystal	4 90 4 90
Y11085	18.432MHz crystal	4 90 4 90
Y11090	20MHz crystal	4 90 4 90
Y11095	24MHz crystal	4 90 4 90
Y11100	27MHz crystal	4 90 4 90
Y11105	32MHz crystal	4 90 4 90
Y11110	36MHz crystal	4 90 4 90
Y11115	48MHz crystal	4 90 4 90
Y11125	32.768MHz crystal	4 90 4 90

Errors & omissions excepted.

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$500 plus	$10.00

HAVE YOU BEEN INTO OUR CITY STORE???

Conveniently located on the edge of the city where parking is easy! Over 4,000sq. ft. of an extensive range of products and great "in store" bargains . . for those interested in computers we have a wide range on display upstairs. For good advice and a good price, see Rod Irving Electronics.

GRAND OPENING

BURANDA - QLD
144 LOGAN RD.

SMOKE DETECTORS

The consumer flop that should never have flopped!

One of the greatest consumer flops of the last decade was the ionization-type smoke detector.

Even though it was a brilliant product is reliable, compact, easy installation, fail safe etc., it just did not sell. Apparently human nature being what it is finds safety-oriented products just not worth the investment however modest. We all know, for example, that accidents and fires never happen to US!!

We all know also, that smoke is the greatest killer in a fire. Many fires smoulder for hours before catching alight and causing physical damage.

The US market research gurus thought that a cheap, compact smoke detector would be a mass consumer item. But boy, were they wrong! When they sold for **$49.50** no one wanted them. The price fell to a very reasonable **$29.99** and still they stayed on the supplier's shelves. Jaycar was called in.

We have now been instructed to sell them for less than ½ this amount!!

Now no-one, no-one has an excuse. You owe it to yourself, your children and family to afford them this simple, reliable and low cost protection. If you are a Hotel, Motel or Lodge operator don't miss this wonderful opportunity to install smoke detectors at a never-to-be-repeated price.

Cat LA-5090

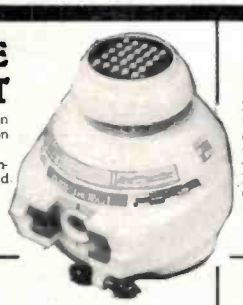
ONLY $14.98

NEW - PROGRAMMABLE MOBILE ROBOT

Low-cost fun learning with this sophisticated robot! Have hours of educational fun programming this fun device to do what you command through the 25-key keyboard on its head!!

FEATURES: ★ 4 bit microprocessor controlled ★ 3 speed gears selected by programming thru' micro ★ Can travel in 4 directions plus angles and curves ★ Has lights and audio ★ Complex routines can be easily programmed (up to 48 commands long).
Cat. XR-1024

SAVE WITH JAYCAR - ONLY $49.95



JAYCAR VIDEO ENHANCER

A service to the Professional

Designed by a staff member of a well known Australian University and made in Australia. It is the only 625 line 50 frame PAL-D Australian designed and made unit that we know of. The unit features enhance, core/gamma control and by-pass switch. It will drive up to 3 VCR's at once with no degradation and works well as a video distribution amp as well. This is NOT A KIT and is guaranteed for 3 months.
Cat. AV-6501

SAVE $10

NOT $69.95 ONLY $59.95

12V AC plugpack Cat. MP-3020 **$16.95**

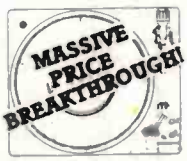
ELECTRONIC BELT DRIVE TURNTABLE - BSR QUALITY

Jaycar has made a sensational SCOOP PURCHASE of B.S.R. belt drive turntables from England at below manufacturers cost!

Two models available AA-0290 works from 9-12V DC and the AA-0292 from 240V AC (includes 12V 400mA adaptor). The DC motor drive is electronically controlled.

SPECIFICATIONS: ★ Dimensions 330(W) x 285(D) x 60(H)mm overall ★ Platter diameter 280mm ★ 2 speed - 33 & 45 rpm (internally adjustable) ★ Pick-up arm counterbalanced type with cueing facility ★ Pick-up ceramic (stereo) with diamond stylus ★ Turntable operation - auto stop, will return to rest automatically, turntable chassis is sprung on all corners with transit screws and clips ★ Weight 1.5kg ★ Output stereo RCA sockets underneath unit.

(Post and Packing this item $5 not $4.50)



SAVE $5.00 PER UNIT

CHECK THE PRICE! Cat. AA-0290
(requires 9-12V DC @ 400mA)

$24.95 ~~$29.95~~

240V VERSION Cat. AA-0292
(Includes 12V 400mA adaptor)

~~$39.95~~ **$34.95**

IMPORTERS DISTRESS STOCK

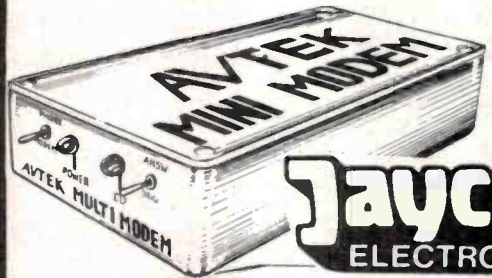
This 400 gram spray can is specially formulated for automotive, marine, electrical and electronic applications.

★ Dries out wet ignitions
★ Protects all metals against rust or corrosion
★ Quickly penetrates and frees rusted parts
★ Lubricates close fitting parts
★ Stops battery corrosion and much more.

Cat. NA-1020

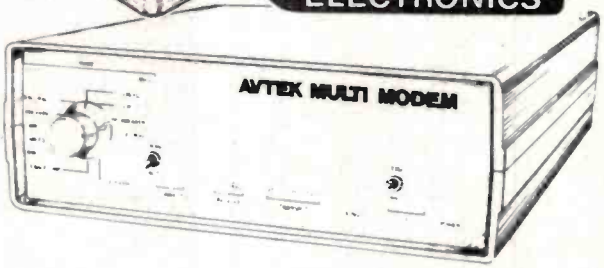
SAVE $3.00
ONLY $3.95

Fast talkers with all the right answers



MultiModem and MiniModem use the latest VLSI technology. Digital signal processing achieves functions normally requiring analogue filters. The result? Reliable data transfer on lines where most modems just won't go!

Jaycar ELECTRONICS



MultiModem only $349 inc. phone

Down the street or across the world, MultiModem speaks the language.

★ 300 baud full duplex, 1200 baud half duplex or 600 baud half duplex, answer or originate
★ CCITT and Bell standards
★ Auto answer and connect ability
★ Plugs straight in (hardwire phone)
★ Superior VLSI chip performance: works reliably with −43dBM signal with S/N ratio of 6dB.
★ Telecom approval C84/37/1135

Cat. XC-4820

MiniModem only $199 inc. phone

★ 300 baud full duplex
★ Answer/originate
★ Plugs straight in (hardwired phone)
★ Superior VLSI chip performance (identical to MultiModem).
★ Telecom approval C84/37/1173

Cat. XC-4825

"A GREAT XMAS GIFT FOR VIC-20 OR TI-99 COMPUTER USERS"

BRILLIANT! BOOK/SOFTWARE COMBINATIONS!

Just in hot off the press from the U.S. Publisher! This is the latest way to buy packaged software. You basically get a vinyl case (similar to the case you get when you rent a video tape), a book and a software cassette. The book describes the program and also gives the program listing. The cassette has all of the programs in the book recorded on both sides. On one side of the cassette is a listing of the programs as they appear in the book. Many of the programs COULD contain additional entries to improve operation and provide additional features. If your interest is in programming use this side of the tape. You can then make your own changes and additios to the basic program so that you can see just what happens when the changes are made. Side 2 is an "enhanced" version of the programs. This version contains additions to the basic programs to provide more error checking and easier operation for those users whose primary interest is not in programming. The Book/Software combinations represent incredible value-for-money compared to ordinary cassettes! See the specific info on the current titles.

TI-99/4A COMPUTER
"51 FUN & EDUCATIONAL PROGRAMS"

As the title suggests, 51 good examples of TI BASIC in action. They are programs that have practical and useful applications. Programs can be changed to suit specific needs.
The book (94 pages 135(w)x215(h)x8(d)) contains 4 sections as follows: Learning computing by working with numbers and characters - 18 program examples; "Having Fun with Graphics & Sounds" - 10 program examples; "Having Fun with Puzzles & Games" - 11 program examples; "Using Educational Programs for Easier Learning" - 12 program examples.
The cassette has all programs on each side one in standard form the other "enhanced". Both book and cassette come in colourful vinyl case measuring 165(w) x 230(h) x 30(d)mm.

Cat. BS-0750 **$17.95**

TI-99/4A: 24 BASIC PROGRAMS

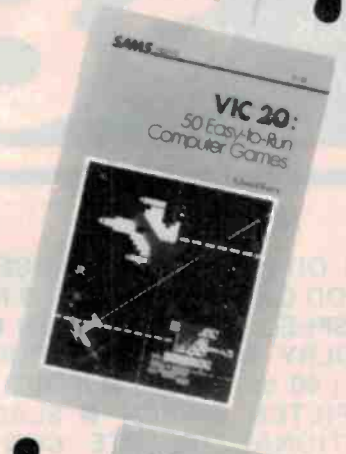
24 programs all in TI BASIC. This book/software product runs from child/adult entertainment games to highly applicable household utility and service programs. 6 chapters in all (plus appendix) with many program examples under every chapter heading. Book dimensions 135(w)x215(h)x13(d). 220 plus pages. The cassette supplied has enhanced and standard listings of each program as well. Overall dimensions 165(w)x230(h)x30(d)

Cat. BS-0754 **$19.95**

TI-99/4A COMPUTER
"Entertainment Games in TI BASIC & Extended BASIC"

This book enables the TI computer user to get and play arcade-type games at a very cheap price. With the addition of joysticks and the TI Extended BASIC module you can use this product to its full extent.
Twenty programs in all are included in 21 chapters (one for each program plus a chapter on programming notes). Program titles include: "S.A.M."; "Arrow Zap"; "Cosmic Guns"; "Typing Skill"; "Address Inventory"; "Skeet Shoot"; "Space Battle"; "Killer Crabs Attack"; "Dungeon"; "Black Tunnel" & "Meteor Rescue".
The book measures 135(w)x215(h)x10(d) and has over 170 pages. The accompanying cassette has standard and "enhanced" versions of each program to make loading easy. The entire package is once again enclosed in a colourful vinyl case measuring 165(w)x230(h)x30(d)mm.

Cat. BS-0752 **$19.95**



VIC-20
"VIC-20: Games, Graphics & Applications"

The Commodore VIC-20 has many special features including ★ User definable character sets ★ Four musical voices ★ A real time clock ★ Colour ★ Graphics.
The book teaches you how to use all of the above features through 20 programs designed for use on the 5K and expanded VIC-20. Whilst the book is great for new VIC-20 users, advanced VIC programmers will find it stimulating as well! Apart from this the book contains joystick games and programs for home applications. Twenty chapters include: "Computer ESP"; "Mind Reading"; "Album Timer"; "Stock Market"; "Floor Planner"; "Motor Race"; "VIC Organ"; "Auto Writer" & "Urban Renewer". Over 130 pages in this 135(w)x215(h)x8(d)mm book. Once again the cassette provides standard and "enhanced" versions of each program. Packaged in a colourful 165x230x30 vinyl case.

Cat. BS-0762 **$19.95**

VIC-20 COMPUTER
"VIC-20: 50 Easy-to-Run Computer Games"

The 135(w)x215(h)x8(d) 122 page plus book describes each of the 50 programs and provides program listing as well. Whilst most of the programs are fairly simple, (no program is over 30 lines) the games cover a wide range of skill and ability levels. This product is ideal for the novice programmer who also likes to play games on his VIC-20.
The cassette supplied has the programs as per the book listing and an "enhanced" version of each program on the other side. Once again the product is packaged in an attractive vinyl case the same size as the other products mentioned here.

Cat. BS-0760 **$18.95**

NEW KITS
This month's kits from EA

DELUXE METAL DETECTOR -
This very sensitive unit works as well as units costing hundreds more! Features special English-made quality case and prewound and sealed head assembly. Looks just like the $700+ units! (All parts supplied).
Cat. KA-1554

ONLY $239

DRILL SPEED CONTROLLER

This brand-new design gives you better speed regulation over previous drill controller designs. It's also easier to make as all parts are mounted on the PCB. All parts supplied including special high voltage MR754 diode.
Cat. KA-1555

ONLY $24.95

EPROM COPIER

Now you can quickly and easily duplicate the contents of one EPROM into another! Copies the contents of 2708, 2716 & 2732 to 2716 or 32! PCB and parts including 2 x ZIF sockets.
Cat. KA-1557

ONLY $69

NEW KITS FROM ETI

ETI 1422 BUDGET PA COLUMNS -
Even if you aren't a carpenter you can make effective PA columns even on a small budget! The design uses standard cuts of chipboard available from most local hardware stores and a special low-cost Jaycar 6" speaker! Get the speaker from us and the rest from anywhere!
Cat. AS-3011
4 OHMS
As used in ETI prototype.

ONLY $2.95 each
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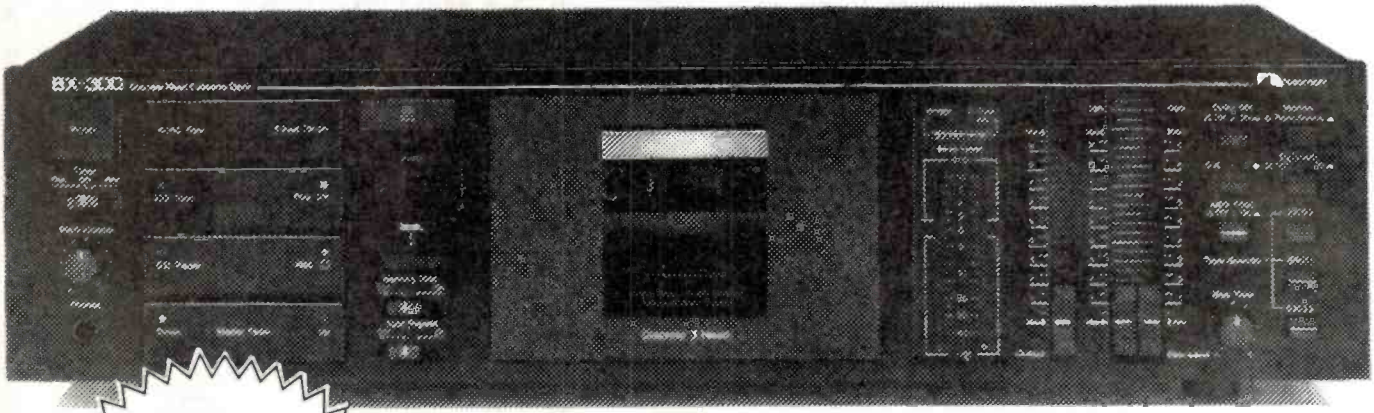

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Motor sound doubles up

AM Stereo is expected to revolutionize both listening habits and the demand for audio equipment over the next year or two.

Australia's car radio suppliers have been quick to jump on the bandwaggon. Pioneer Electronics introduced their latest product, the KE-A433AM, as the Minister for Communications, Mr Michael Duffy announced that radio stations will shortly be permitted to broadcast stereo signals on the AM band utilizing Motorola C-Quam.

Motorists stand to benefit most from AM Stereo as the stations can be received over a far greater range than the very limited reach of FM signals. This is an obvious plus for country driving and improved listening. Motorists, however, don't face any real increase in the cost of receivers. Expected to retail under $350, the Pioneer KE-A433AM is an in-dash combination cassette/radio unit which receives both AM and FM stereo and AM mono signals via a Quartz-PLL Supertuner III.

The tuner section features feather-touch presets for 12 FM and 6 AM stations, auto up/down seek and local seek. Built-in PNS, an FM Auto/Mono switch, black on green liquid crystal frequency display and preset station indicators. Auto replay, locking fast-foward and rewind, tape guard and a metal/chrome tape play button are features of the cassette section.

Meanwhile, Pioneer will also release its new "Centrate" component car audio product range soon. Centrate is an innovative top-end system which will demonstrate Pioneer's technical and development capabilities in car audio systems.

The centre-piece of Centrate is Pioneer's FEX-90 pre-amp tuner deck combination. It's DIN-sized with European smooth face design. The FEX-90's focal point is its pictographic function/display door which conceals the cassette entry.

Like the tape insert and eject operations, cassette loading is controlled by a full IC Logic Direct Drive motor for precise operation. Individual motors are used for tape play, rewind and fast forward. This Logic Control also enables features like multi-play music search and pre-set electronic tuning.

A complimentary range of modular components, ranging from a practical half-DIN sized graphic equalizer to amplifiers and speakers able to handle outputs up to 150 Watts (max) per channel, take the Centrate story further.

The Pioneer EQ-003 seven-band pre-amp equalizer with dual amplifier balancing and automatic sound leveller can be accompanied in the same DIN dash slot by the similarly sized pre-amp controller for the optional GTS-X80 sub-woofer.

This remote glass fibre and polyester blended flat diaphragm speaker is driven by a separate 100 W (max) mono main amplifier housed in the same resonance-free aluminium die-cast enclosure. In this form, it can be located on the rear parcel shelf or on the rear floor.

Pioneer is recommending one of two high powered amplifiers to compliment the Centrate system: the 60 W (max) per channel GMA120 and the monster 150 W (max) per channel GMA200. Both need to be remotely mounted in the vehicle to achieve best results, such as in the boot.

Pioneer is not looking for volume sales with Centrate. At a retail price for the complete system likely to approach $2500 the product is a flag waver for the Australian car sound market leaders. It is also likely to be keenly sought after by many car audio enthusiasts whose music tastes have been raised over recent years by products such as those in the Pioneer Component range which Centrate now eclipses in performance and features.

For more information contact **Pioneer, PO Box 295, Morialloc, Vic 3195. (03)580-9911.**

OBITUARY

A POSTHUMOUS award was made to Mr Spencer A. Hughes at the annual award dinner of the federation of British Audio on May 10 at the Cafe Royal, Regent Street, London, for 'outstanding service to the industry'.

Spencer Hughes was the chairman and senior technical director of Spendor Audio Systems Ltd, whose loudspeakers are widely used by the British Broadcasting Corporation, Independent Broadcasting Authority, British Telecom and many other professional organisations, as well as the domestic consumer and extensive export markets.

Hughes is most famous for the BC1 loudspeaker, which is probably the only pre-1970 designed speaker still in production. It is found in a variety of professional locations in Australia.

New amp from Meridian

A new amplifier, the first from Meridian since the seminal 103/105 series, in production for nearly eight years, is designed to offer "highest performance, great versatility and absolute reliability," according to their publicity.

Designated the MPA, it is a dual-mono design, with two identical separate power supplies based on the 'switchmode' system, first devised by Bob Stuart for the MCA Zebra integrated modular amplifier system released earlier this year.

Nominal power output of the MPA in normal stereo operation is 70 watts per channel into 8 ohms. The amplifier can easily be bridged for mono using a factory-made accessory lead, when it will deliver up to 200 watts into 8 ohms.

Meridian's Bob Stuart, Britain's self-styled 'leading light' in innovative audio technique, has incorporated many of the highly-developed circuit ideas first realised in the MCA Zebra system into the new amplifier.

Of these, most tangible is the balanced input facility, which allows full advantage to be taken of the low noise floor resulting from the new switchmode power supplies through very high common-mode noise rejection and precise matching to Meridian's flexible modular linear preamplifier system.

Meridian MPA styling harmonises with other current Meridian products, and its tough steel case is finished in durable and attractive grey Nextel. Inputs are via DIN or RCA sockets, outputs via 4 mm sockets and remote control on/off switching is available via fitted tip/sleeve phone jacks.

The MPA amplifier is available now from Meridian outlets at approximately $1350 r.r.p. For the name of your nearest retailer and further information on the complete Meridian range, contact **Mike Bartlett, Audio 2000, PO Box 107, Brookvale 2100 NSW. (02)939-2159.**

Digital stereo

NAD has released its new digital stereo FM/AM receiver, the model 7140, on to the Australian market.

It features digital frequency synthesis tuning, which produces what the makers claim is superior audio sensitivity and quieting. The preamp is designed to be interfaced with moving magnet pickups as well as moving coil cartridges and CD players. The entire amplifier has a dynamic range sufficient to meet the most demanding requirements even of compact disc players, according to the manufacturers.

The 7140 is rated at 40 W per channel and has a variable impedance output to allow you to drive the speakers to full power regardless of their impedance. It will deliver 80 W in peak bursts.

The phono preamp does not use ICs, but a pair of low-noise transistors in a differential input circuit. Circuit gain may be increased by twenty to adapt the input circuitry for different input signals.

The NAD 7140 features a bass equaliser section that amplifies the deep bass response and an infrasonic filter to eliminate rumble. It also has a high current output stage that is able to deliver peak currents greater than 30A for precise control of speaker voice coils even when the speaker impedance is as low as 2 ohms.

The FM section has an input sensitivity of 1.7 μV/300R with AM rejection of better than 65 dB. Total harmonic distortion is 0.09 per cent. The AM section has a sensitivity of 300μV/meter and selectivity of 35 dB. Image and IF rejection are both claimed to be 50 dB.

For more information contact the **Falk Electrosound Group P.O. Box 234, Rockdale NSW 2216.**

Production video monitor

A new 20" colour video monitor with four-system compatibility has been released in Australia by GEC.

The monitor is designed for use in production situations and features a fully-equipped interface section to link with other segments of a complex video system. The new TC-2000EUM monitor can be used with four colour formats — PAL, SECAM, 3.58 NTSC and 4.43 NTSC.

An NTSC tint control is also included in the monitor to help gain the proper flesh tones with NTSC signals. It features the famous Quintrix in-line picture tube with a black matrix configuration. A front panel selector is provided on the TC-2000EUM to allow operators to switch between VTR, line and camera input signals, while the rear panel includes a BNC-type monitor-out jack to link it to another monitor.

Up to two additional monitors can be connected in series to provide three images from a single source. The TC-2000EUM has an automatic source compensation circuit which eliminates unevenness in performance due to fluctuations in the power supply. It also has pin-type (RCA) audio input and output terminals and an 8-pin VTR connector.

The TC-2000EUM is available in Australia through **GEC Australia, 2 Giffnock Avenue, North Ryde NSW. (02)887-6222.**

Ear tranny launched

Sportswatchers and radio fans of Australia — help is at hand. A new lightweight radio which can be worn on the ear has just been released.

Called Ear Tranny, the AM radio allows footy fans, racegoers and golfers to listen to a radio and keep both hands free at the same time.

Unlike walk-around style radios, Ear Tranny is a 40 mm diameter self-contained unit weighing just 20 grams. The cordless battery-powered radio can be hooked onto either ear and sits easily in place for long listening periods.

Ear Tranny is available through major stores for $17.95 including battery.

For further information contact **Futuretronics, 79 Levanswell Rd, Moorabin, Vic 3189. (03)579-2266.**

Car stereo

Sanyo has announced the release of a new car stereo cassette player with 7.5 W per channel output.

The balance and tone controls of the FT-800 have an easy-to-operate slide mechanism, and a play indicator shows you when the deck is in operation. A light in the volume knob enables easy location of the knob when driving at night. The extra-compact design of the FT-800 allows easy installation.

The FT-800 is available from electrical retailers, department stores and selected car accessory outlets for around $59.95.

For more information contact **Sanyo, 14 Mars Rd, Lane Cove NSW 2066. (02)428-0822.**

Spectrum from Hughes

Hughes Communications has announced its appointment as sole Australian distributor for the entire range of premium quality Spectrum audio components.

First shipments will include the full range of TRP Spectrum loudspeakers, with models rainging from diminutive bookshelf units to professional studio monitors.

Each model in the range has been designed to maintain phase coherency of the wavefront over the entire operating frequency spectrum. Each speaker is tested via B & K measuring equipment as it comes off the production line. The result is a sound that challenges the transient response and low distortion figures previously associated only with electrostatic designs, but at a fraction of the price.

All models can handle power commensurate with their size and are finished in rosewood or pine. Prices vary from $549 for the bookshelf (TRP Model VIII) to $1179 for the Model VI, to $1799 for the studio monitor.

For more information contact **Hughes Communications, 2/58 Moonya Road,· Carnegie Vic 3163. (03)568-0612.**

OFFICIAL AM STEREO START

Radio stations throughout Australia would be able to start broadcasting in AM stereo from 1 February, 1985 according to the Minister for Communications, Mr Michael Duffy.

The decision to adopt 1 February as the official starting date follows negotiations with representatives of the radio industry. The most important consideration was that the three-month period before 1 February would enable all stations wishing to broadcast in AM stereo to install equipment to meet the Motorola standard.

The go-ahead for AM stereo and the decision to adopt the Motorola system as the Australian standard were announced by the Minister on 8 October, 1984.

The three month period before the official start would also enable importers and distributors of AM stereo receivers to make available a wider range of models for consumers to consider.

'A SIGNIFICANT ADVANCE'

KEF's 104/2 speakers reviewed

"Wide dynamic range", "low colouration", "stable stereo imaging" are just some of the claims KEF makes about its new 104/2 speakers. Louis Challis tested them and agrees: maybe not pushing 'state of the art' to the extreme the 104/2 speakers are certainly a step forward.

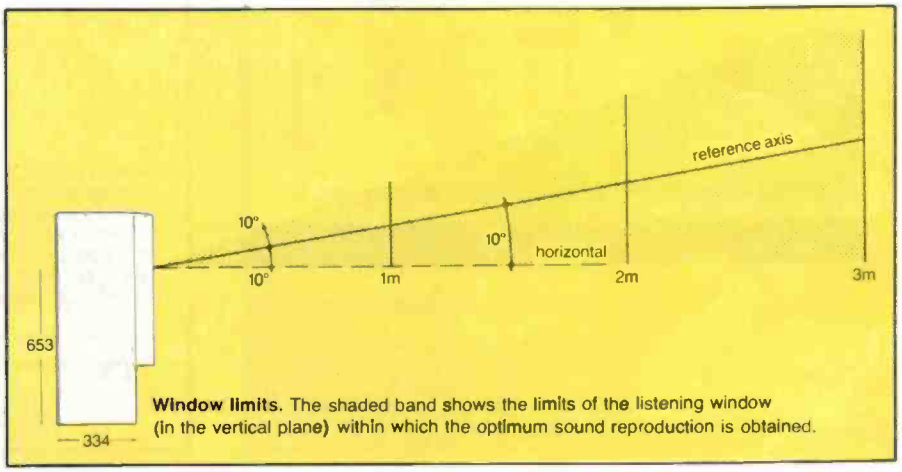
Louis Challis

THE TECHNICAL DIRECTOR of KEF, Laurie Fincham, is a relatively quiet and unassuming engineer. The firm for whom he works, KEF Electronics Ltd of Tovil, also tends to be relatively unassuming, but obviously in the commercial sense, not as quiet. I first met Laurie Fincham in Moscow in 1974 at a meeting of the International Electro-Technical Commission (TC 29). It was there that I and a number of other national representatives first became aware of the outstanding development work that KEF had undertaken in the objective analysis of how speakers sound. Many other people had tried to achieve a similar goal, but Fincham was the first person to actually produce an objective test for loudspeakers which really correlated "with the way a loudspeaker sounds".

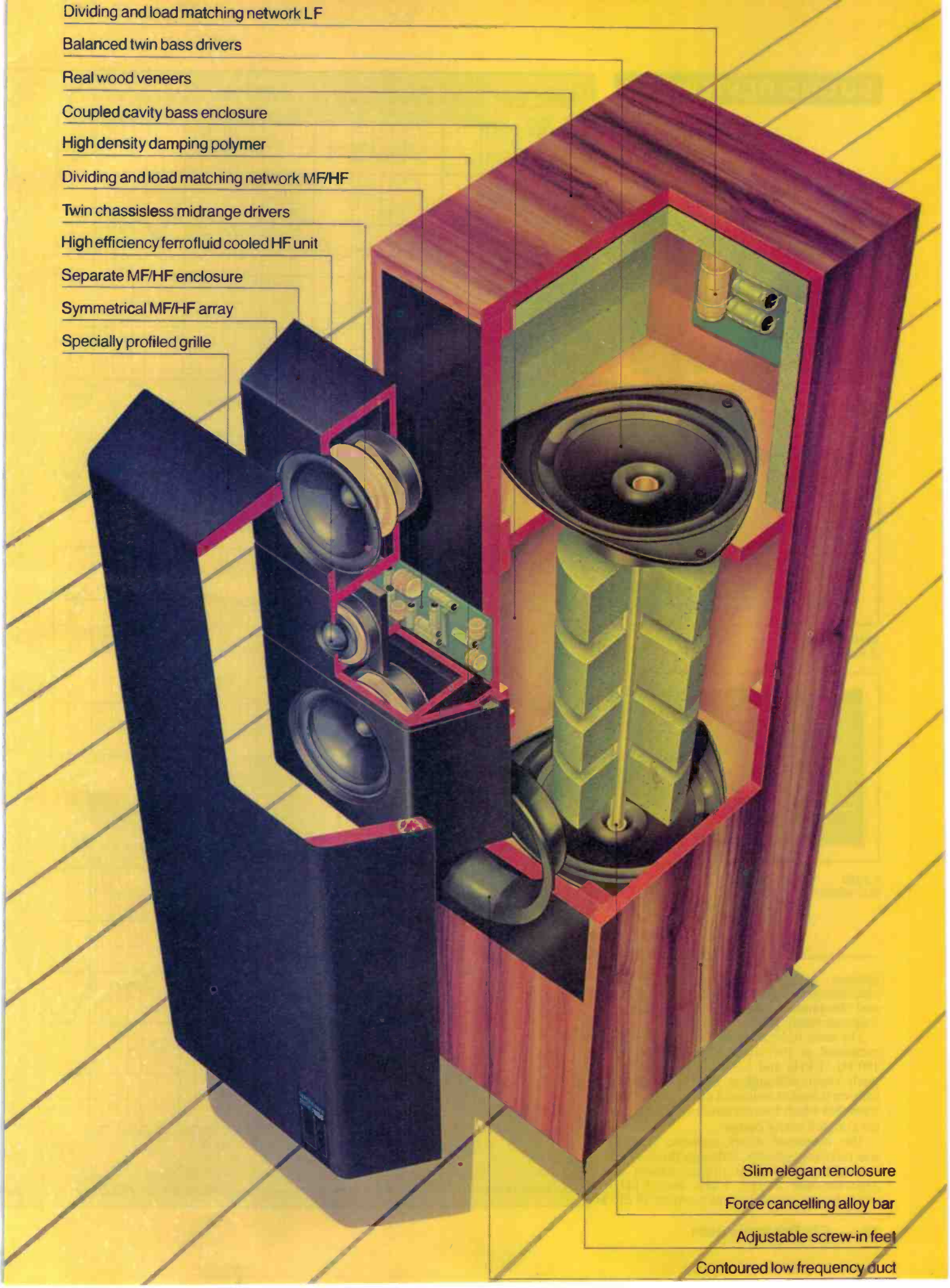
In the ensuing years, what KEF had developed became the 'industry standard'

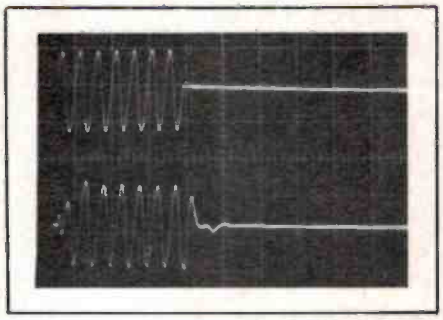
KEF 104/2 speakers

Dimensions:	*900 mm high x 280 mm wide x 415 mm deep*
Weight:	*32 kg*
Manufactured:	*In Kent, England by KEF Electronics Ltd*
Recommended Retail Price:	*$1 999 per pair*

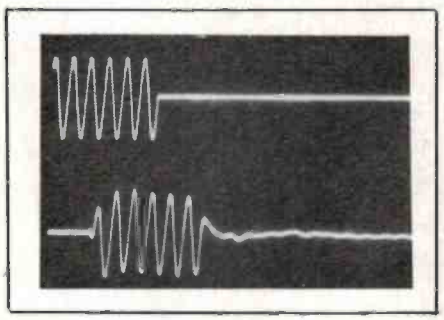


Window limits. The shaded band shows the limits of the listening window (in the vertical plane) within which the optimum sound reproduction is obtained.

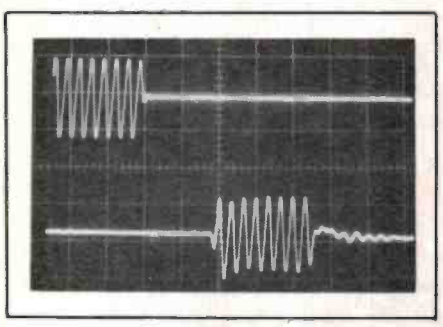

Dividing and load matching network LF
Balanced twin bass drivers
Real wood veneers
Coupled cavity bass enclosure
High density damping polymer
Dividing and load matching network MF/HF
Twin chassisless midrange drivers
High efficiency ferrofluid cooled HF unit
Separate MF/HF enclosure
Symmetrical MF/HF array
Specially profiled grille
Slim elegant enclosure
Force cancelling alloy bar
Adjustable screw-in feet
Contoured low frequency duct



100 Hz
(20 ms/div)



1 kHz
(2 ms/div)

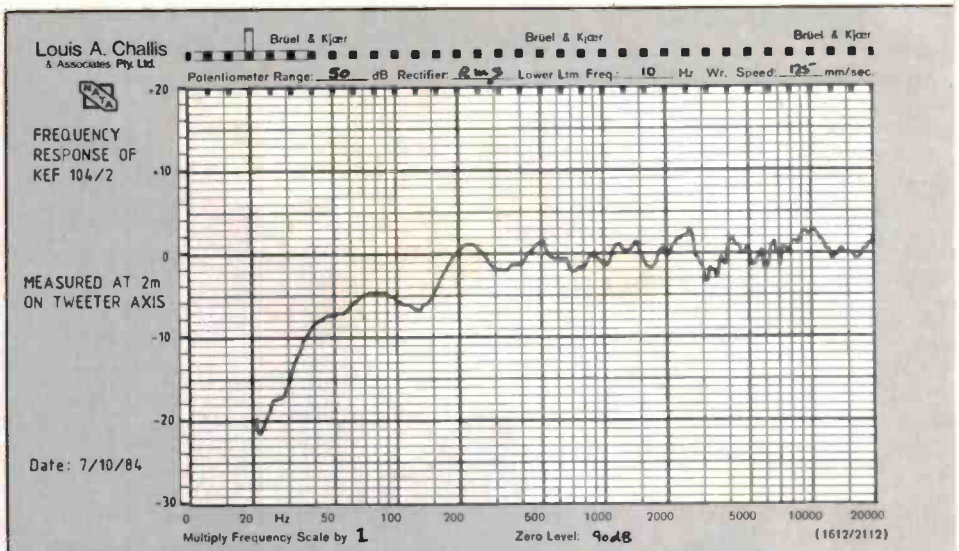


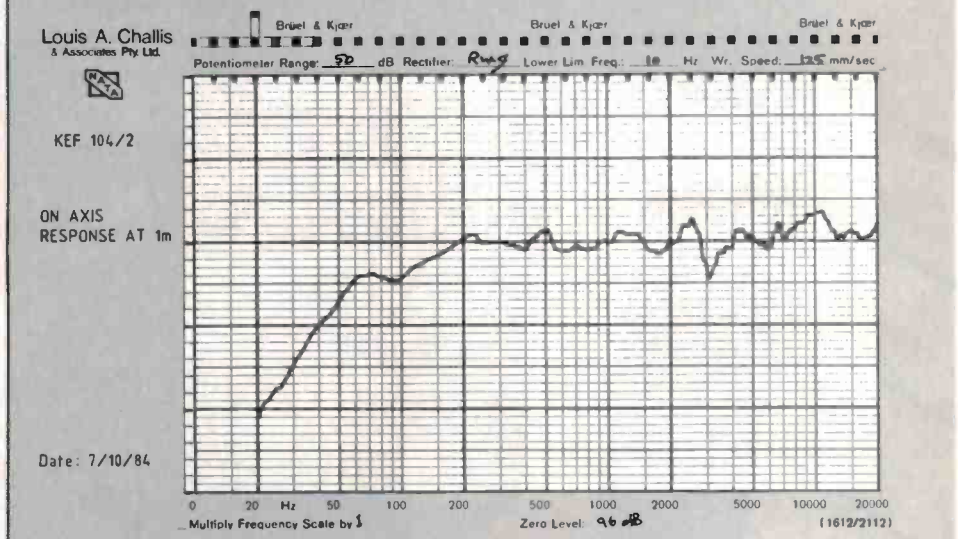
6.3 kHz
(0.5 ms/div)

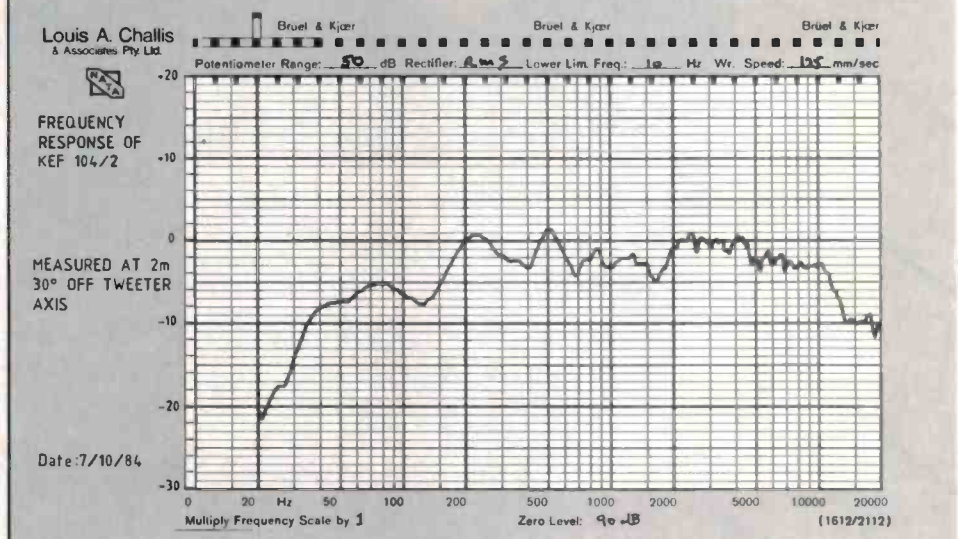
systems using multi-driver units. This characteristic is not however, deleterious and the phase response of this speaker is unquestionably good.

The tone burst response for the speaker measured at the standard frequencies of 100 Hz, 1 kHz and 6.3 kHz were all relatively clean, although at 100 Hz the initial turn-on transient indicated a different effect from that which I would have expected from the coupled cavity design.

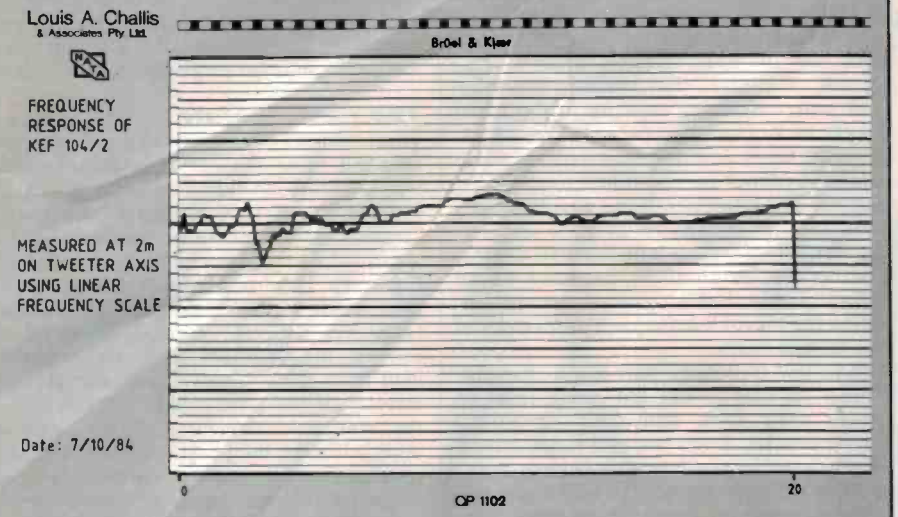
The measured decay response spectra was relatively smooth, although there were a couple of significant ripples evident at approximately 2 kHz, 4 kHz and 5 kHz which became significant at between 10 dB ▶

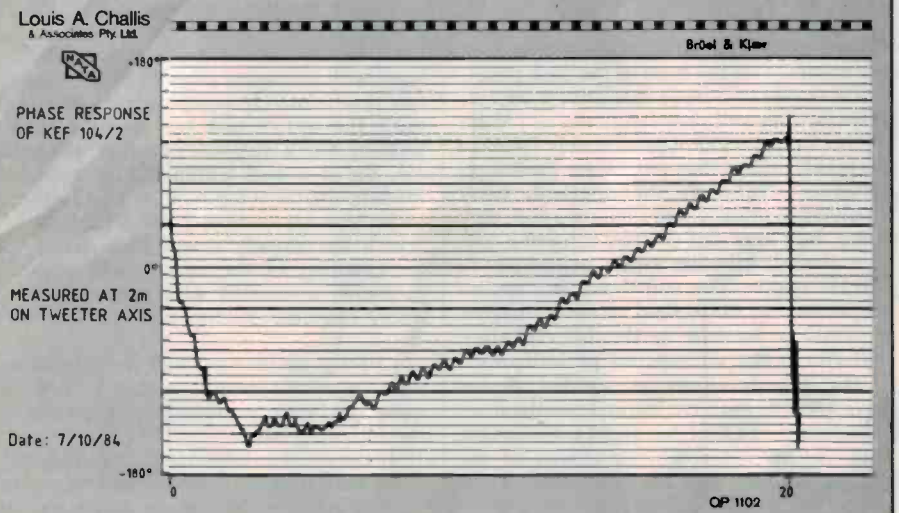


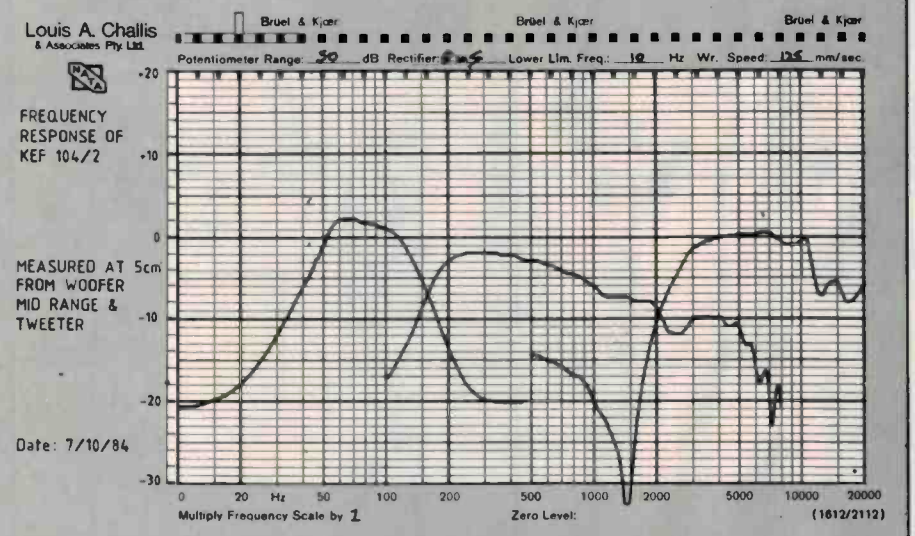




Tone burst response of KEF model 104/2 (for 90 dB steady state SPL at 2 m on axis). Upper trace is ele

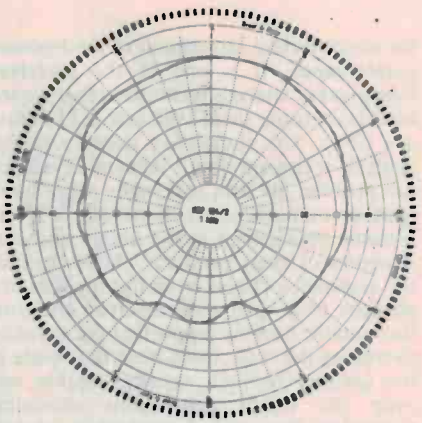


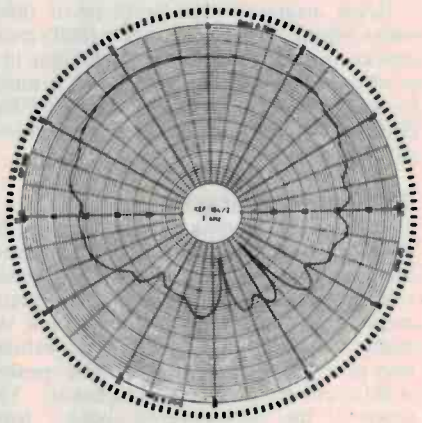


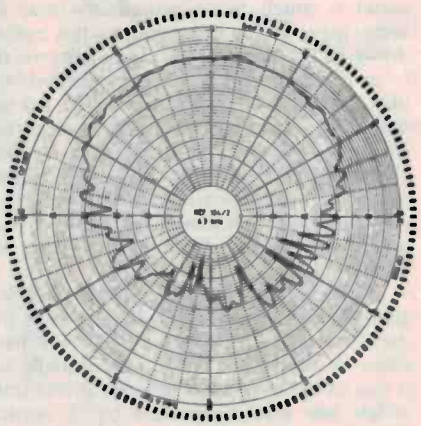


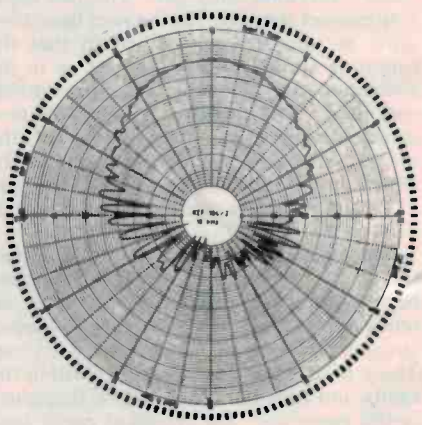
. Lower trace is loudspeaker output.

Polar response plots.









for the objective assessment of loudspeaker performance. It is one of the preferred loudspeaker analysis techniques that we too have been using since 1980 (see ETI February 1981). The cumulative decay response analysis technique that Fincham developed has enabled his firm and many other loudspeaker manufacturers to isolate different acoustic deficiencies in the design and construction of their products. These include the resonance effects from the speaker diaphragm, from speaker enclosures, and from the metallic baskets supporting the speaker, as well as the reflections from the inside of the speaker cabinet, speaker basket and even the minor protrusions extending beyond the face of the loudspeaker cabinet.

Being aware of such problems is obviously helpful, being able to accurately measure them is obviously better, but being in a position *to be able to obviate them* is much harder and an examination of what KEF has done to achieve that aim is the point of this particular review.

The new design

The KEF 104/2 monitor loudspeaker probably incorporates more outstanding technological advances than any other loudspeaker released in the last five years. This statement, it should be noted, is mine not the manufacturers. The outside of the cabinet may give you some inkling that this speaker is different from other loudspeakers. The shape of the cloth-covered speaker front panel is much more prominent (and for some inexplicable reason does not extend down to the floor). When you remove the front panel you find a plastic moulded box-like structure on the face of which are two mid-range speakers flanking a centrally mounted tweeter. This structure has a truncated tapered appearance and is fixed above a large aerodynamically shaped loading port also moulded from plastic, which is set back under the lower edge of the plastic box structure.

Looking through the loading port you gain your first insight into what makes this speaker system substantially different from other loudspeakers. What you actually see is one of the two low frequency driver units which are inter-connected by a vertical 'force cancelling alloy bar'. The two separate magnet structures of the twin bass drive units are mechanically linked so that the opposing vibrations normally set up in the individual chassis structures are positively cancelled. This linked bar coupling procedure ensures that the energy of the magnet assembly, which would normally be coupled to the speaker cabinet and result in a 'boomy' or 'boxy' speaker colouration, is minimised.

The resonance effects of the bar itself and the cavity resonance in the enclosed space between the two bass drivers is further attenuated by interposing a series of shaped circular foam plastic elements over the bar. These reduce the standing waves within the cavity and provide a smooth low frequency sound generator. The 'coupled cavity bass loading system' provides maximum power handling capacity in the 70 to 100 Hz region where KEF claims normal programme content has its peak spectral energy. This means of course, that speaker distortion and power handling capacity in the lower 40 Hz to 70 Hz range (where some of my records, tapes and discs have considerable content) cannot be controlled to the same degree. The attributes of this coupled cavity bass loading system result in a low frequency driver system with acoustic characteristics similar to those provided by an infinite baffle, but without necessarily suffering the loss of low frequency efficiency of the infinite baffle.

The low frequency port has a diameter similar to that of the mid-range units to match their style and their directional characteristics. These two mid-range drivers incorporate the revolutionary feature of dispensing with speaker baskets which give rise to so many resonance problems in the conventional loudspeaker. In their place KEF has used the high strength plastic moulded box structure which incorporates an unusually high level of dampening. Speaker diaphragms are mounted on the back of the front panel and the drive magnet assemblies are mounted on the front of the back panel.

These two mid-frequency drivers operate from the unusually low frequency of 150 Hz up to a frequency of approximately 2 kHz, a far greater range than normal for mid-range speakers. Although the speakers carry much more sound energy than normal, they share their load and thereby achieve a better sound distribution in the critical 200 to 400 Hz region. The soft dome tweeter incorporates a ferro-fluid cooled magnet structure to increase its thermal efficiency and also to provide superior performance.

The improvements in speaker design have gone beyond the normal electrical requirements and KEF has spent considerable time on little details. The design of the speaker cabinet and the front grille cloth cover has been carefully attended to reduce resonance effects, diffraction effects, and sound cancellation effects to produce what KEF states is one of the finest loudspeakers it has yet produced.

The peak feature

While most of these features are commendable and, to say the least, unusual, I believe that the most novel and undoubtedly exciting feature of their design is the incorporation of what KEF describes as its "Conjugate Load Matching System" [2,3] (see Figure 1). This impedance matching system goes much further than the conventional cross-over network, which is intended to provide the amplifier with a compatible load from the complex impedance characteristics of the loudspeaker system. What the conjugate matching system actually does is to take the peaks and bumps of the speaker system's reactive components and add in parallel, the opposite reactive impedances provided by those peaks and bumps. The overall load impedance curve that the amplifier sees at the speaker terminals is thus a 'flat' resistance curve with almost negligible reactive components (see Figure 2).

Obviously to develop a cross-over network with conjugate impedance characteristics is a relatively complex task. It is not quite the sort of task you would consider tackling with a slide rule or a pocket calculator, but it is well within the capability of modern digital computers. It also happens to be one area where KEF's technical research has already scored high marks for its handling of the much more difficult problems associated with the analysis of decay response spectra back in the early 70's.

KEF has decided to tailor the overall impedance of this speaker system to 4 ohms, not 8, and have justified this procedure on the following bases:

1. If the speaker impedance does not drop below 4 ohms (or rise above it) then the amplifier should not be distressed by

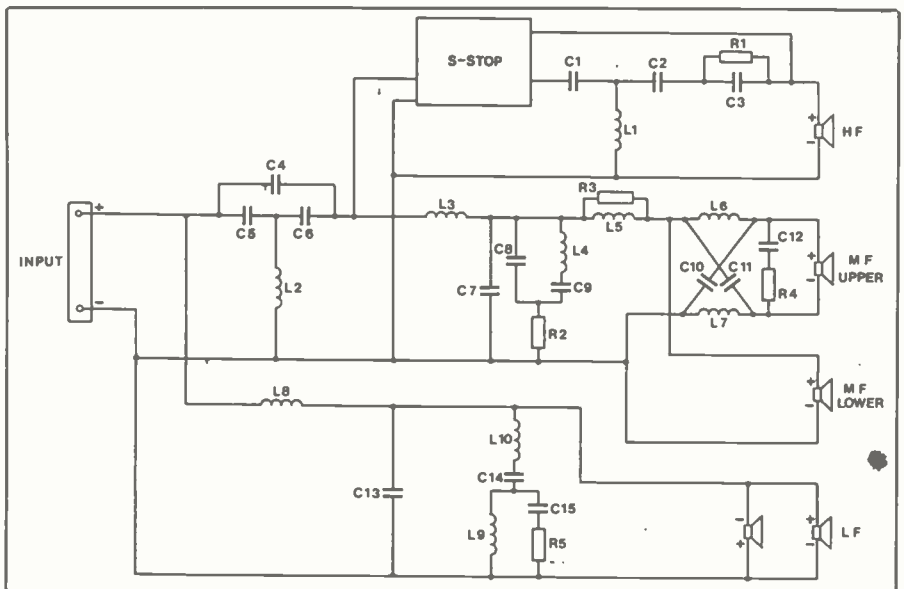


Figure 1. The 'conjugate load matching' crossover network.

LOUDSPEAKER DATA SHEET

MEASURED PERFORMANCE OF: KEF MODEL 104/2

SERIAL NO: 001059

FREQUENCY RESPONSE: 50 Hz to 20 kHz +

CROSSOVER FREQUENCIES: 150 Hz to 2.3 kHz

SENSITIVITY:

(for 96 dB average at 1m) 6.2 V r.m.s. = 8.5 Watts (nominal into 4.5 Ohms)

HARMONIC DISTORTION: (for 96 dB at 1m)

	100Hz	1kHz	6.3kHz	
2nd	-42.6	-54.1	-42.5	dB
3rd	-42.4	-61.5	-56.5	dB
4th	-	-	-59.1	dB
5th	-56.8	-66.8	-	dB
THD	1.07	0.22	0.77	%

INPUT IMPEDANCE ONE TEST:

	100Hz/7kHz 4:1	
100Hz	4.8	ohms
1kHz	4.0	ohms
6.3kHz	4.4	ohms
Min at 700 Hz	4.0	ohms

Date: 7th October, 1984

KEF 104/2. Tabulated characteristics as measured.

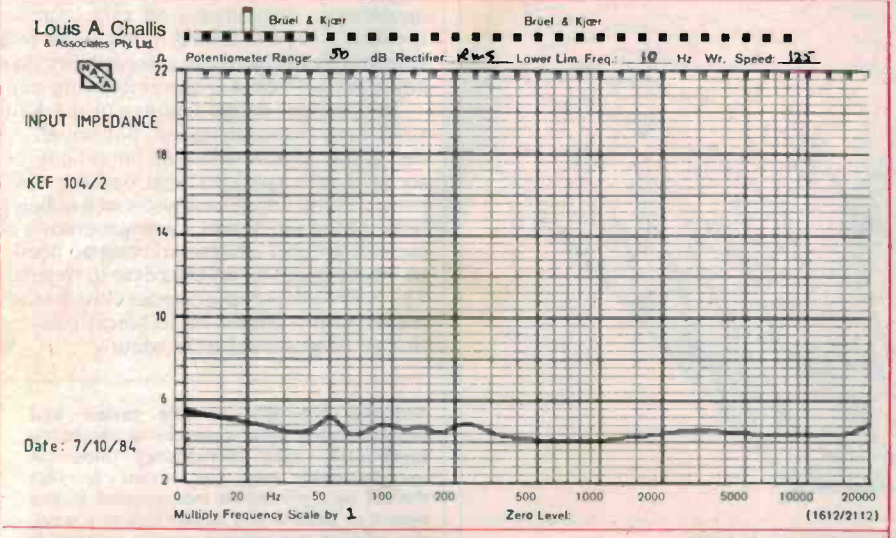


Figure 2. Ever seen an impedance curve this flat before?

transient signals falling anywhere within the overall frequency response, as the perceived load is basically a 'resistor'.

2. If the speaker impedance is 4 ohms then the amplifier is capable of delivering almost twice the power into the speaker load and you don't necessarily need to buy a bigger amplifier to produce more sound.
3. With the lower impedance, the effective sound pressure level for 1 watt of input power is materially increased so that the 'quasi-efficiency' of the speaker system is improved.

How it tested

The objective evaluation of this speaker confirmed most of the salient characteristics which the manufacturer had claimed and revealed a few that it hadn't. The first set of parameters which we evaluated was the frequency response and polar plots in our anechoic room. At two metres on the tweeter axis the frequency response proved to be reasonably flat, being with ±6 dB from 50 Hz to 20 kHz, although the response exhibited a trifle more 'lumpiness' below 150 Hz than I would have expected.

Even allowing for the lack of flat response below 150 Hz, the frequency response from 150 Hz to 20 kHz is almost flat enough for you to perform calibration assessments on your microphones or on your living room to assess standing wave characteristics. Repeating the frequency response curve, at 30° off axis revealed a quite perceptible change in the top of the high frequency curve with 10 dB of attenuation being apparent in the 13 to 20 kHz region. Some ears will detect that drop off axis and it is readily measurable.

We repeated the frequency response test at one metre from the tweeters as a control and this revealed a slightly flatter response, although the lack of precise matching of outputs below 150 Hz was still present. Having determined the basic frequency response characteristics of the speaker it was obviously appropriate to assess its impedance characteristics. Not unexpectedly, the impedance curve proved to just as the manufacturer promised, essentially flat at 5 ohms ±1 ohm right across the frequency spectrum from 10 Hz to 20 kHz. Over the frequency region 20 Hz to 20 kHz the impedance curve proved to be just as the the flattest impedance curve that I have ever seen and I suspect is also the flattest that I am likely to see for quite some time to come.

The polar plots assessing the directional energy distribution at 1 kHz, 3 kHz and 6.3 kHz were exceptionally smooth and well within the manufacturer's claims. At 10 kHz however, the primary lobe was somewhat narrower than the manufacturer's claim of being within 2 dB at ±30° in the horizontal plain. I measured a 6 dB droop which is still reasonably good and more in keeping with what I would have expected from a small dome tweeter set back behind the face of the speaker cabinet.

The phase response was remarkably smooth, although the interactions between the two mid-range drivers and the tweeter did give rise to a 'ripple' effect which I have previously observed in a number of other ▶

"The KEF 104/2 speakers are unquestionably the most outstanding new speakers to be released in 1984. Because they perform so well and are so visually unobtrusive . . . they will probably 'win more approval' for living room compatability."

and 25 dB below the transient peak signal level. The best feature of the speaker is its high frequency response, the worst feature its mid-frequency response, which is not as good as I would have expected.

The distortion characteristics of the speaker were particularly good at normal listening levels and with an output signal of 96 dB at one metre there was only 1% harmonic distortion at 100 Hz, a paltry 0.22% at 1 kHz and a somewhat higher 0.77% at 6.3 kHz.

These objective test results are in the main very good, although not superlative considering the advanced technology that has gone into their achievement. However, it is obviously essential to balance such testing with the subjective evaluation which I was delighted to perform.

The subjective result

The test set-up that I chose for the subjective evaluation of these speakers was based on a comparison of the 104/2 monitors with a pair of B & W 802/F monitor speakers driven by a Yamaha 101M amplifier and a C2 pre-amplifier. The source material was provided by a Sony CDP101 CD player, a Technics model SL5 direct-drive turntable fitted with SME Series 111B arm, a Shure V15/IV cartridge and Audio-Technica AT30E cartridge.

The material used for the evaluation was firstly a series of tried and well-proven test records carefully selected for the purpose. These revealed, on normal orchestral material, the stereo imaging capabilities of the KEF 104/2 speaker systems to be above average, in fact generally excellent, provided you stay within the optimum listening area. This was defined by a point which is 600 mm above the floor and up to 30° above and within a lateral angle of ±20° to the main axis of the speaker. As you move off axis from either one of the pair of speakers, the stereo imaging is significantly impaired and you experience a significant degradation in imaging response.

During the transient testing with the Swedish Hi-Fidelity Institute test record *LJUD och hur det ska lata,* I measured the average peak signal level which I considered appropriate for acceptable subjective distortion: I found it to be typically 107 dB at two metres on axis and 104 dB at three metres on axis.

At higher signal levels there were audible changes which indicated second order distortion products. These changed the nature of the original sound signal to a point at which I could already detect unacceptable speaker colouration.

With the aid of two brilliant new CD discs from Denon Mozart's *Quintets N-7-21* and Shubert's *Winterreise op 89 D911-No N-10-21,* which are fine examples of the latest digital recorded CD discs, I was able to evaluate the high frequency characteristics of the 104/2s with classical music and with voice. I satisfied myself that the performance of these speakers is very close to the quality of reproduction but not indistinguishable from that provided by the B & W 802/F reference monitors I was using.

With the latest Telarc disc *Star Tracks* CD80094 containing John Williams' brilliant music played by the Cincinnati Pops Orchestra in 'Star Wars', 'Superman', 'Return of the Jedi' and 'Raiders of the Lost Ark', I was able to subject the speakers to music with some of the widest dynamic ranges currently available on CD discs. These pieces confirmed that the speakers perform exceptionally well at frequencies from 60 Hz to 15 kHz, but they do not provide quite the same superlative performance below 60 Hz, particularly where the deep drum rolls and Moog synthesised components incorporate loads of low frequency response calling for a flatter bottom end. More significantly, these pieces revealed a trace of stridency between 2 kHz and 5 kHz particularly on wood wind instruments.

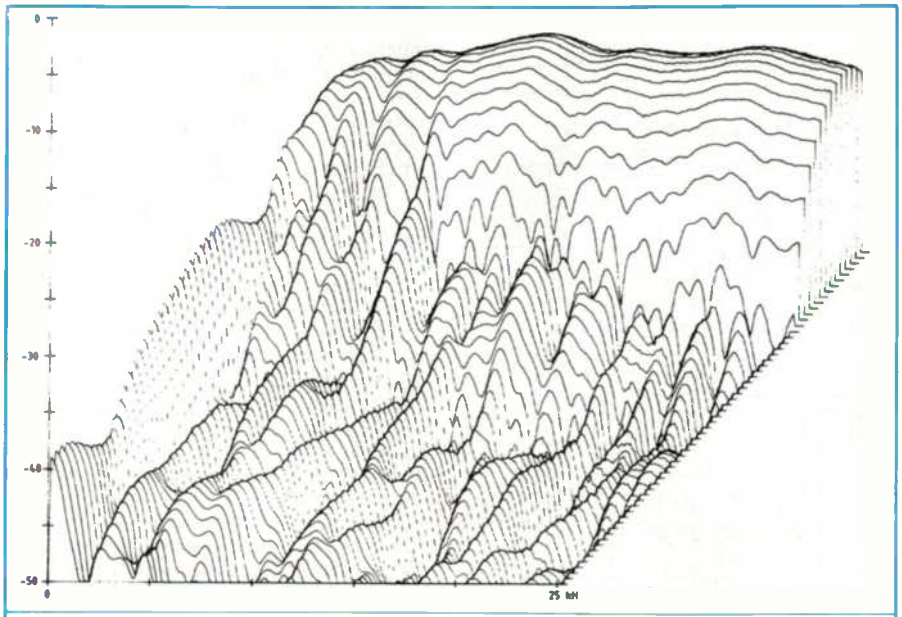
On 'classical' rock, for example The Police's *Ghost in the Machine* AM Records CD53011, the 104/2s performed remarkably well giving adequate performance provided you don't wish to reproduce the same levels that I experienced at the group's Sydney outdoor concert this year.

The last series of tests performed with the Denon audio-technical CD test record 38C39-7147 which enabled me to once again assess both the subtleties of the speaker, as well as the latest changes in my listening room, using both wide band pink noise (track 90) and the bands of filtered pink noise (tracks 80-89) which are perfect for that application.

In summary

The KEF 104/2 speakers are unquestionably the most outstanding new speakers to be released in 1984. They will provide most of their prospective purchasers with as good a performance as they could wish. Because they perform so well and are so visually unobtrusive compared with other similar speakers, they will probably 'win more wife approval' for living room compatibility than any other loudspeaker currently being sold.

The unusual design features of the KEF 104/2 have overcome many, but not all, of the major electro-acoustic limitations associated with speakers' and baskets' resonance. Those improvements as well as being 'state of the art' herald a new generation of esoteric speaker designs creating an acoustic environment closer than ever to 'reality'. The KEF 104/2 speaker comes close to such reality with a degree of technical panache that all of us should truly admire. ●



Decay response spectra. Some refinement needed around 2 kHz to 5 kHz.

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Regards *Jack O'Donnell*

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EA OCT '82 P26-28
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Just check the features. We are sure that you will calculate that the "Voyager" represents outstanding value!
FEATURES: ★ Instant fuel consumption in litres/100km and MPG! (most others have only one of the above) Just switch from one to the other as you drive along. ★ Instant speed, time and other fuel data. ★ Visual and audible excess speed alarm.
INSTALLATION: The "Voyager" comes complete with an unbelievable array of mounting configurations, on dash, under dash or stalk mount. All installation hardware is supplied (even a roll of insulation tape!) as well, of course, as the speed and fuel sensors. A lavishly illustrated installation manual is provided as well as a comprehensive operators manual.

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BOTH MODELS FULLY WEATHER PROOF

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30 WATT WITH LINE TRANSFORMER

Multitap inbuilt line transformer allows taps 330/30W, 660/15W, 1000/10W, 2000/5W. Universal swivel mounting bracket supplied.

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4 or more..... **$67.80**

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Multitap inbuilt line transformer allows 2 taps 660/15W, 1K/10W, 2K/5W, 4K/2.5W. Mounting bracket clears line TX allowing rear wall mounting.

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Two Models 5&10 Watt 8 ohm
Fully weatherproof. New unique voice coil construction ensures high dependability on full drive.
Suitable for PA Intercom and security systems etc.

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C 2010 5W	$9.50	8.50
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Supplied on 200m rolls, enclosed in tough PVC bags in the traditional way. Enables tangle free extraction from centre of roll through hole in the side of PVC bag.

FOUR WIRE
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W 0302 per metre ..... .50
per 200m roll $46.00

SIX WIRE (Three Pair)
RED/BLACK/BLUE/
WHITE/GREEN/ORANGE

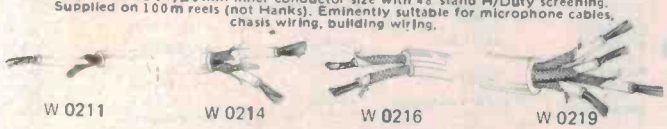
W 0303 per metre ..... .60
per 200m roll $56.00

20 WIRE (10 Pair)
Pairs 1-5 BLUE/ORANGE/GREEN/BROWN/SLATE with White mates
Pairs 6-10 BLUE/ORANGE/GREEN/BROWN/SLATE with Yellow mates

W 0310 per metre $1.50
per 200m roll $200.00

SHIELD AUDIO CABLES

Lap screened 14/.12mm inner conductor size with 48 stand H/Duty screening. Supplied on 100m reels (not Hanks). Eminently suitable for microphone cables, chasis wiring, building wiring.



W 0211 | W 0214 | W 0216 | W 0219

SINGLE CORE	TWIN CORE	TWIN CORE Fig "8"	4 CORE
Per Metre 40	Per Metre . .50	Per Metre . .60	Per Metre $1.00
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MASSIVE PRICE BREAKTHROUGH!
ELECTRONIC BELT DRIVE TURNTABLE
BSR QUALITY

Altronics has made a sensational purchase of **Belt Drive Turntables - BELOW** Manufacturers Cost!! Because of our buy we can pass them on to you at a **MASSIVE SAVING.** The Turntables are made in England by B.S.R. They are unmounted and suitable for Disco Consoles, 3-in-1's etc. They are also ideal as replacements for existing 3-in-1 sets. (See Specifications) But there is an aspect that is **really amazing!** You can work the Turntable from 9-12V DC. This means that you can run the unit from a car or truck!! (The A 0612 model can of course run on 240V mains) The Turntable features quality Belt Drive operation, lightweight Transcription type arm, Cueing facility and Stereo Ceramic cartridge with Diamond Stylus. The platter has calibration markings to check speed. A simple neon on 240V will 'strobe' to the markings) Whilst the 33 & 45 rpm speed has been accurately set in the factory, you have the facility to make pitch adjustments underneath the turntable. The DC Motor Drive (as used in the best turntables) is electronically controlled!! Each unit comes with complete instructions. Quantity limited! You will have to hurry to avoid disappointment.

SPECIFICATION

- Dimensions 330 (W) x 285 (D) x 60 (H) mm overall.
- Platter Diameter 280 mm.
- 2 speed 33 and 45 rpm.
- Pick up Arm Counter balanced type with cueing facility.
- Pick-up ceramic stereo with diamond stylus.
- Turntable operation - auto stop, returns to rest automatically. Turntable chassis is sprung on all corners.
- Output stereo RCA sockets provided.
- Weight 1.5KG.

AMAZING LOW PRICE
CAT A 0612 **$29.95**

240V VERSION (includes 12V adaptor)
CAT A 0614 **$39.95**

Freight Packing - due to the bulk and weight of this unit - freight is $5.00 per unit.

"MICROBEE KEYBOARD"

Now ONLY $19.50

Microbee is a registered trademark of Applied Technology PTY Ltd

D1510 **$29.95**

Full 60 Key Qwerty Computer Keyboard exactly the same type that has been used with the famous Microbee Computer SPST Keys Complete with mounting plate **(Fully Assembled).**

Superlative MICRON SERIES II MONITORS

★ 1050 lines resolution at centre screen. ★ 22MHz bandwidth. ★ Video input impedance switch allows networking use. ★ Incredible — repeat Incredible — resolution.

Guaranteed (we mean it) to out perform any other low cost monitor in Australia.

$20 OFF THIS MONTH

D 1115 Series 2 Nonglare Green **$199.50**
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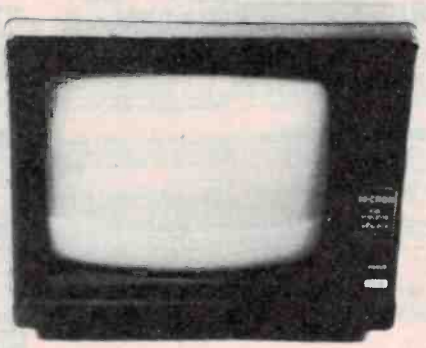
SPECIFICATIONS:
Screen — Green phosphor. **Front Controls** — Power on/off, character brightness/intensity, display centering. **Rear Controls** — Background intensity, vertical and horizontal adjustment etc. **Input Impedance** — Switch 75/10K Ω. **DC Socket** — 12V DC output at 1.1 amp — power your micro direct from the monitor. **Bandwidth** — 10Hz-22MHz. **Resolution** — 1050 lines minimum at centre screen.



Stereo signal generator

The recent launch of AM stereo has created a need for stereo signal generators for all types of audio system testing.

The VP-8253A from National is designed to provide AM stereo multiplex signals for measurement and test of the fidelity and separation of AM stereo receivers in any of the four AM stereo systems.

It permits preset of frequency, output level and modulation for easy operation. With a conventional signal generator, even skilled operators need a long time to adjust all controls for the required setup. But with this signal generator, it is easy to preset up to 100 front panel setups for instant use.

The built-in memory backup battery protects preset data stored in random-access memory (RAM) even when the power switch is turned off. These settings can easily be changed from the front-panel to suit new test and measurement requirements.

Oscillation frequency stabilized by a phase-locked loop, high output level at 13 dBm (19 dBm for CW), easy operation by interlocked preset, control by GP-IB interface, memory control and other features make this signal generator a convenient research and development instrument as well as an efficient production tool for AM stereo receivers.

This unit covers the frequency range of 200 kHz to 2 MHz. Resolution is 10 Hz. Parameter settings may be entered using either the numeric keys or the rotary encoder knob on the front panel.

The output may be arranged to provide L=R, L only, R only, or L=−R mode using an external or internal test tone.

A front panel switch enables selection of two built-in test tones: 400 Hz and 1 kHz.

A negative peak clipper is available for the main channel. The pilot signal frequencies and modulation ranges are 25 Hz and 0-10% for C-QUAM and CPM, 15 Hz and 0 to 10 for ISM, and 5 Hz (0-10.0 rad) for am-pm.

For more information contact **Scientific Devices, 2 Jacks Rd, South Oakleigh, Vic 3167. (03)579-3622**

Analogue/digital panel meter

Sifam has introduced a cased version of its 'Harmony' dual read-out, digital/analogue, multi-range, programmable panel meter.

The Harmony was launched about two years ago as a component device for building into OEM equipment, with its LCD display and associated pc board designed for mounting together on a panel, or separately within equipment circuitry.

However, following a demand for non-specialist users, the company has developed a self-contained Harmony meter, fully enclosed within a standard DIN 43700 — 96 mm x 48 mm moulded case.

The Harmony resembles a conventional LCD digital meter, but it also incorporates an analogue bar beneath the digital reading which expands or contracts in proportion to the reading.

It incorporates a microprocessor and can be programmed as a multi-range meter covering several different measurement functions or ranges. A separate sector of the LCD can be used to flag the specific range being measured at any one time.

The meter also can be programmed to act as a set-point meter to initiate alarm or control functions at pre-settable low or high set-points.

For more information contact **C & K Electronics, 15 Cowper Street, Parramatta NSW 2150. (02)635-0799.**

PCB drilling machine

A high quality pcb drilling machine, designed for accurate and reliable work, is available from RS components.

The machine is constructed of strong aluminium frame and base with phosphor-bronze drill bearing to give excellent operating stability. The high speed drill operates at 18000 rpm and offers a large throat depth of 240 mm. This machine incorporates a powerful vacuum unit with a flexible extension tube and adjustable head. The vacuum unit removes all drilling swarf to keep boards clean and clear for drilling. The suction tube and unit are easily removed and emptied of collected swarf (no separate bag needed). Two sliding depth stops limit the drills vertical movement and an adjustment for drill handle tension offers a wide range of operator control.

The pcb drilling machine is powered by 240 V. All motors and secondary controls operate from an internal 12 V supply. The controls on the machine include illuminated on/off switch, drill on/off switch with indicator, suction on/off with indicator, automatic drill and suction with indicator, and working area lamp on/off. For protection both primary and secondary circuits are fitted with panel fuses.

For further details on this machine, stock no. 606-664, contact **Radiospares Components, 28 Northwood Street, West Leederville, Western Australia 6007. (09)381-4799.**

Sound level meter

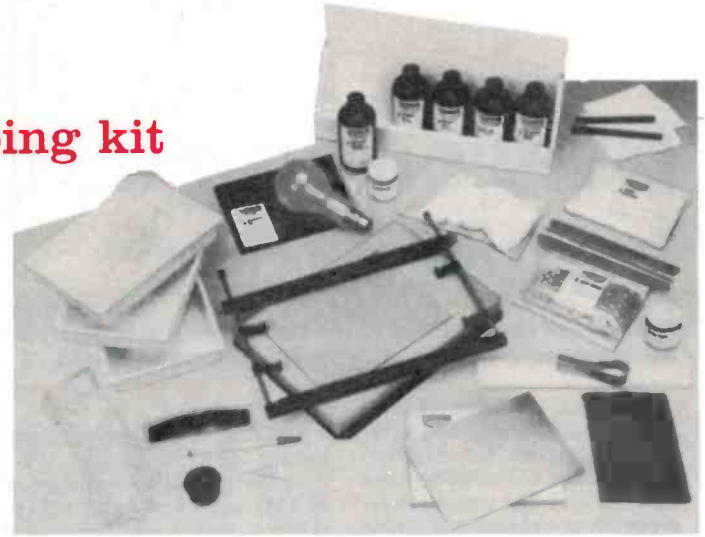
A high quality environmental monitoring sound level meter, type 1404D, has been released by RS Components. Supplied to RS by Dawe Instruments, this meter provides a direct reading over the range 34 dBA to 130 dBA.

The instrument consists of a highly stable and robust ceramic microphone, weighting network, attenuators, high-gain amplifier and an indicating meter. The internationally standardised A-weighting frequency response is used to provide readings which correlate best with subjective noise assessment. Thus this meter is ideally suited to measurements relevant to hearing conservation and noise annoyance checks. The normal response of the meter is very rapid, to simulate that of the human ear. An alternative slow response may also be selected, to give an average of fluctuating sounds. The meter is also useful for a wide variety of audio checks e.g: loud speaker output, alarm and audible warning device levels.

The low current consumption permits the use of a single small dry battery, giving a typical operational life of 100 hours. Each meter is complete with a battery, carrying case and a very comprehensive manual.

For further details in the RS Sound Level meter, stock no. 610-988, contact **Radiospares Components, 28 Northwood Street, W. Leederville, WA 6007 or phone (09) 381-4799.**

Comprehensive PCB prototyping kit



The Electrolube CM100 Circuit Maker kit provides virtually everything needed for making positive photographic film masters from same size tape patterns or published layouts. It also provides everything necessary to produce either single or double sided boards from the resulting positives.

Just released on the Australian market by Richard Foot Pty Ltd, the local representatives for Electrolube, the CM100 Circuit Maker kit extends the company's product range beyond its well known range of chemicals and service aids for the electronics industry. The CM100 is described as a comprehensive system for the creation of professional quality circuit boards, and provides virtually everything needed to produce photo-etched boards in small volumes. It should therefore be suitable for schools, colleges, R & D labs, model shops or anyone else who needs to produce small quantities of high quality boards.

The kit really consists of two separate sections. One contains all of the items necessary to produce film positives, and the other the items necessary to produce boards from the positives. No darkroom or camera is required. For film-making you get:

12 sheets of autopositive film (160 x 100 mm);
a photoflood lamp (240 V, 500 W);
chemicals: developer parts A and B, fixer, clearing solution;
universal exposure and assembly frame;
retouching pen;
photographic dishes, plastic gloves;
liquid measure, liquid crystal thermometer;
cotton wool, film clips, lint-free cloth;

and for board-making you get these additional items:

6 double-sided fibreglass PCB blanks (160 x 100 mm);
photoresist, applicator holder and foam strip;
chemicals: photoresist, copper etchant, flux/protective lacquer;
2 x 1.1 mm HSS twist drills;
scouring pad.

Also included in the kit is a brochure giving step by step instructions on how to produce both film positives and finished PCBs from them, and a troubleshooting chart.

The CM100 Circuit Maker kit normally sells for the recommended retail price of $180.20, but is currently available at a special introductory price of $129. Further details from the Electrolube agents and distributors, **Richard Foot Pty Ltd, 75 Chandos Street, St Leonards NSW 2065. (02)439-1391.**

THE BRILLIANT SERIES 5000

STILL GOING STRONG

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 "Super Finish" front panels at no extra cost, top quality components supplied throughout. Over 1,000 Sold.

For those who haven't that 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 are used where possible.
- ★ Aluminium case as per the original article.
- ★ All components are top quality.
- ★ Over 1000 of these kits now sold.
- ★ Super Finish front panel supplied at no extra cost.

Please note that the "Superb Quality" Heatsink for the Power Amplifier was designed and developed by ROD IRVING ELECTRONICS and is being supplied to other kit suppliers.

SPECIFICATIONS: 150 W RMS into 4 ohms
POWER OUTPUT: 100 W RMS into 8 ohms (±55 V SUPPLY)
FREQUENCY RESPONSE: 8 Hz to 20 Hz, +0, -0.4 dB 2.8 Hz to 65 KHz, +0-3 dB. NOTE: These figures are determined solely by passive filters.
INPUT SENSITIVITY: 1 V RMS for 100 W output.
HUM: 100 dB below full output (flat).
NOISE: 116 dB below full output (flat, 20 KHz bandwidth).
2nd HARMONIC DISTORTION: <0.001% at 1 KHz (0.0007% on Prototypes) at 100 W output using a ±56 V SUPPLY rated at 4A continues <0.003% at 10 KHz and 100 W.
3rd HARMONIC DISTORTION: <0.0003% for all frequencies less than 10 KHz and all powers below clipping.
TOTAL HARMONIC DISTORTION: Determined by 2nd Harmonic Distortion (see above).
INTERMODULATION DISTORTION: 0.003% at 100 W, (50 Hz and 7 KHz mixed 4:1).
STABILITY: Unconditional.

Cat. K44771 — Normally $319, **$299**
packing and post $10

PREAMPLIFIER

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

- ★ 1% Metal Film Resistors are supplied.
- ★ 14 Metres of Low Capacitance Shielded Cable are supplied (a bit extra in case of mistakes).
- ★ English "Lorlin" switches are supplied (no substitutes here).
- ★ Specially imported black anodised aluminium knobs.

Available Assembled and Tested. (We believe that dollar for dollar there is not a commercial unit available that sounds as good.)

SPECIFICATIONS:
FREQUENCY RESPONSE: High-level input: 15 Hz-130 KHz, +0, −1 dB Low-Level input – conforms to RIAA equalisation, ±0.2 dB.
DISTORTION: 1 KHz <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 300 mV input signal at full output (1.2V) >92 dB flat > 100 dB A-weighted. MM input, master full, with respect to full output (1.2V) at 5 mV input 50 ohms source resistance connected, >86 dB flat; 92 dB a-weighted MC input, master full, with respect to full output (1.2V) and 200 uV input signal: >71 dB flat >75 dB A-weighted.

Cat. K44791 — Normally $289, **$259**
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BANDS: 28 Bands from 31.5 Hz to 16 KHz.
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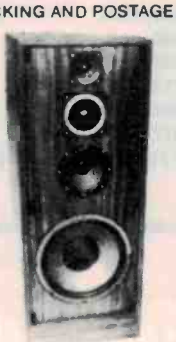

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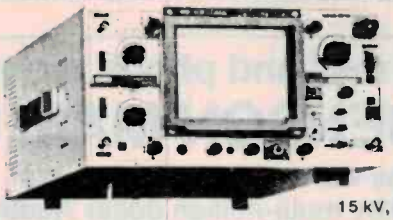

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CAT. NO.	MODEL	SCREEN	SENS	BG DEL	TRIG DEL	B'WIDTH	T'BASE	WITHOUT PROBES	TAX EXEMPT	WITH PROBES	COMMENTS
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Q12105	620	150mm	5 mV	N	N	20 MHz	0.5uS-0.5Sdiv	$548	$495	$589	(45 MHz-6 dB)
Q12100	B155	95mm	8 mV	N	N	18 MHz	0.5uS-0.5Sdiv	$895	$645	$785	(AC-DC Operation)

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VOYAGER OPERATING FEATURES:

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Hundreds sold of the old version at $199, now you can grab a new improved model, including a full 90 day warranty, for a mere $125!! **That's a colossal saving of $74!!**
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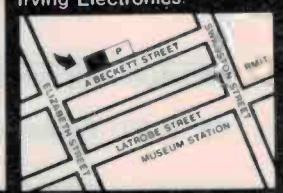


Honeywell claims record for IC density

Among the latest chips to be successfully fabricated under Phase 1 of the Very High-Speed Integrated Circuits program initiated by the US military are two from Honeywell. The program director, Dallas D. Burns, bills them as "the most complex bipolar chips ever built."

The Honeywell sequencer and arithmetic chips — part of a three-chip set to be used on an electro-optic signal-processing brassboard, integrate 136 000 and 121 000 devices, respectively. Both chips were fabricated using 10:1 direct-step-on-wafer technology. This involved all-dry etching in an oxide-isolated integrated-Schottky-logic process. It features 1.25 μm minimum geometries and three levels of metal.

Notably, fully functional arithmetic chips were produced on the first silicon pass in June, says Burns, while the sequencer chip required only metal mask modifications after the first run. The third chip in the set, known as the parallel pipeline processor, will mix ISL and current-mode-logic on the same chip and will integrate 142 000 devices. It is scheduled to complete its second pass in silicon during September. As with the sequencer, only minor metal errors were found after the first silicon pass; Honeywell says these can be fixed by changes on only the last two of the 15 or so masks used to fabricate the chip.

All three chips were designed using a library of 43 macrocells, some of which contain as many as 2000 gates. The majority of these cells contains between 200 and 600 gates, however. Tape automated bonding is used to mount each chip in a ceramic 180-pin array package.

Optical-fibre components

Mitsubishi Electric has launched a range of fibre optic devices claimed to be at the forefront of fibre optic technology.

It covers practically the full range of optoelectronic components which are necessary for optical fibre communication systems.

The range includes light-emitting and receiving modules which contain light-emitting diodes, laser diodes and photodiodes, components for optical coupling, optical multiplexing, and optical transmission line changeover, as well as optical transmitter/receiver modules which transmit digital signals with optical fibres.

Mitsubishi Electric in Japan has been at the forefront of this relatively new technology. In fact, the company claims to be the first to recognise the capabilities of light communications and the benefits it can offer in our information intensive society. In recent times it has developed surface inspection equipment for pipes using laser techniques and optical fibres. It scans the pipe material using a linear pipe-transport mechanism without rotating the pipe. This unusual capability makes it possible, for the first time, to incorporate into production lines a scanning device for fine defects in materials with uniform surfaces.

Other research work has culminated in the release of fibre-optic sensors and a range of measuring instruments that incorporate these devices.

For further information contact **Mitsubishi Electric Australia Pty Ltd, 73 Epping Road, North Ryde NSW 2113.**

IC sockets

Molex has released a range of IC sockets known as the Molex M41000 Series.

Designed primarily to house and protect fragile IC leads as well as providing a simple means of replacing faulty ICs or changing ROMs and PROMs whose key functions are likely to be altered, the Molex sockets are supplied in a self-delivery tube and are compatible with most automatic insertion machines.

A special feature of the new Molex sockets is the housing sidewall which guides and orients the IC leads during insertion. Terminals are phosphor bronze, finished in tin/lead with a 0.005 mm minimum thickness.

The sockets, which are stackable side-by-side or end-on-end on 2.54 mm centres, meet performance standards of both MIL 83734-D and EIA standard RS415-A Class II and have built-in flux standoffs.

To cover the full range of applications. Molex has made the M41000 series IC sockets available for 8, 14, 16, 18, 20, 24, 28 and 40 pins.

For more information contact **Utilux, 74 Commercial Road, Kingsgrove NSW 2208. (02)50-0155.**

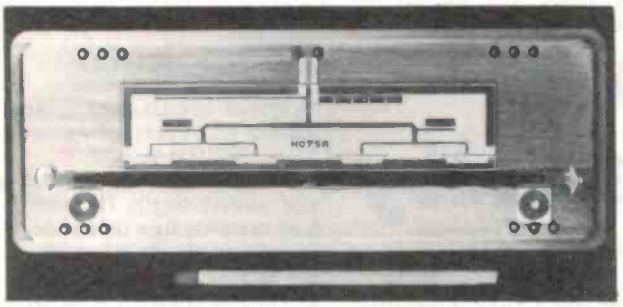
DAC applications

Sydney based Parameters has a supply of DAC application notes from Analog Devices Inc. of the USA.

Specific topics of discussion include single-supply operation of CMOS D/A converters in the voltage-switching or current-switching mode of operation, selection of amplifiers for single +5 V supply operation and interfacing single +5 V supply D/A converters to microprocessors.

The application note details the design of an X-Y plotter interface using two dual-converters and a single 8-bit D/A converter. A useful chart of popular op amps detailing their expected performance when used with CMOS D/A converters in single +5 V applications is also included.

For more information contact **Parameters Pty Ltd, 41 Herbert St, Artarmon 2064. (02)439-3288.**



Pure maths. A surface wave convolver from Siemens with a match-stick for comparison.

Surface wave maths

A passive component for fast analogue Arithmetic operations has been developed by researchers at Siemens and should be commercially available in a year or two.

For interference-free communication in special networks, band-spreading techniques are being increasingly used. Bandwidth can be extended by additional modulation of the signal. This considerably improves transmission reliability.

In this type of transmission system, high-speed arithmetic is necessary to filter out the weak, highly redundant encoded signal from the background noise and interference.

Siemens has developed surface-wave 'convolvers' that realise this function. Convolution is a mathematical operation that performs time-displacement of a signal, multiplication by a reference signal and subsequent integration. Convolvers essentially consist of an acoustic delay line, of which the received signal and reference signal run counter to each other.

The acoustic power density is increased with the aid of focusing structures, so that via the non-linear polarisation of the substrate crystal (lithium nobate) the product of the two signals is formed. The convolution signal is tapped off by a spatially integrating electrode along the path. Surface-wave convolvers that are able to correlate signals with 100 MHz bandwidth and 10 μs duration afford a signal processing capacity corresponding to 10^{11} multiplications per second.

Future applications of the convolver will also lie in the field of extremely high-speed analogue signal correlation for pattern recognition and image processing tasks.

For more information contact **Siemens, 544 Church St, Richmond Vic 3121. (03)429-7111.**

Energy Pak batteries

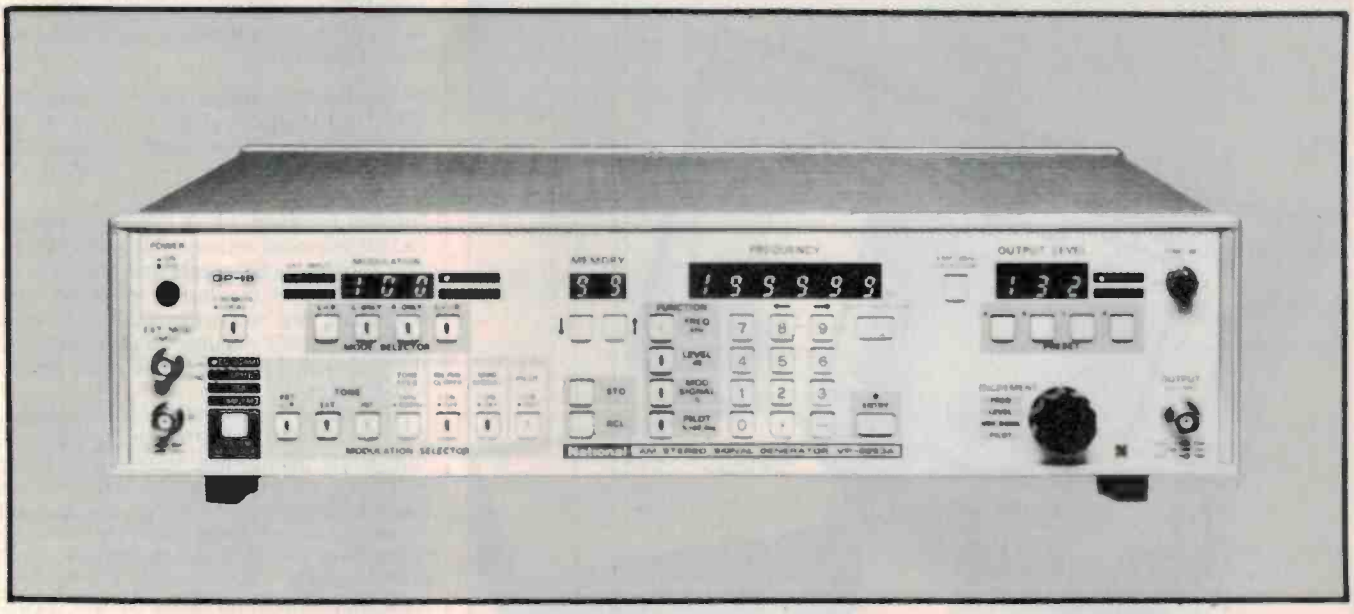
Australian Security Electronics has been appointed Australian agents for 'Energy Pak' sealed lead acid batteries.

ASE is looking for distributors of its six and 12 volt batteries, which come in various sizes between 1.2 Ah and 6 Ah.

Contact **W. J. Sheehan** at **P.O. Box 118, Paddington NSW 2021. (02)331-5142.**

National

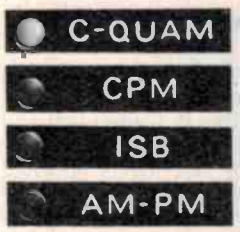
AM Stereo Signal Generator
VP-8253A



FCC-approved AM stereo systems

200 kHz to 1999.99 kHz

- **AM Stereo Systems**



Four built-in AM stereo systems:
Motorola systems (C-QUAM)
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This unit is capable of generating multiplex signals for testing equipment using four U.S. AM stereo broadcasting systems. Switching systems are as easy as pushing the SYSTEM SELECTOR push button.

- Stereo Modulation
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Project 683

MINDMASTER

Human-computer link

Peter Ihnat

There are times when computer buffs require a different type of control to that provided by simple game controllers or joysticks.

A LOST WARRIOR left roaming the dark humid jungle of twisted metal, stone and cement once the great city of Dunedoo (a long time in the future, of course!) rests momentarily against a huge concrete pillar. Within a fraction of a picosecond (i.e: very quickly) the dreaded aliens intent on finding the location of earth's secret headquarters stun our hero with their discharges . . . err . . . capacitor-discharge guns. As he comes to they apply the dreaded BRAIN BLASTER (modified ETI Mindmaster) to his head and connect the Apple II ++++++ to analyse his thought processes . . . WHAT?? A bit far-fetched you say? Well, maybe, but if you let your imagination go for a moment or two, the current project conjures up futuristic images. The ETI-683 Mindmaster was developed as a unit which provides control of a computer by using the mind. In actual fact, the control is indirect. The Mindmaster operates by monitoring certain body processes and it is these which are controlled by the mind. Those into the subject will immediately recognise this as BIOFEEDBACK — the process of obtaining visual (or aural) indication of the operation of a body function and then trying to bring it under conscious control. ETI covered the subject several years ago with a general article and three projects. These were:

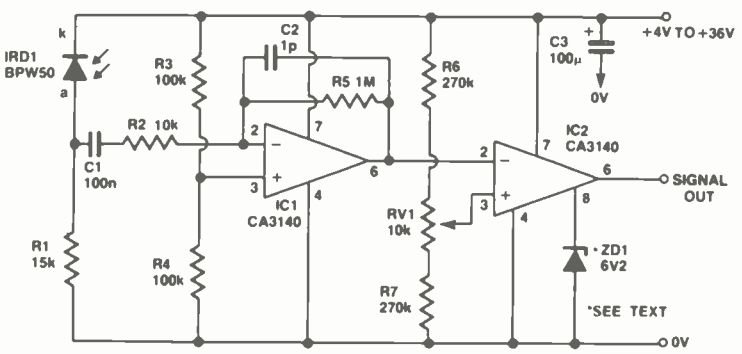
Biofeedback — instant yoga?	Sept. 76
ETI-576 Electromyogram	Sept. 79
ETI-544 Heart rate monitor	Sept. 76
ETI-546 GSR monitor	Mar. 77

Internal functions which can be monitored include muscular activity, skin temperature, skin resistance, heart rate and brain waves. The easiest to monitor is probably skin resistance and since the GSR (Galvanic Skin Response) monitor already performs this function, I used it as the basis for the Mindmaster.

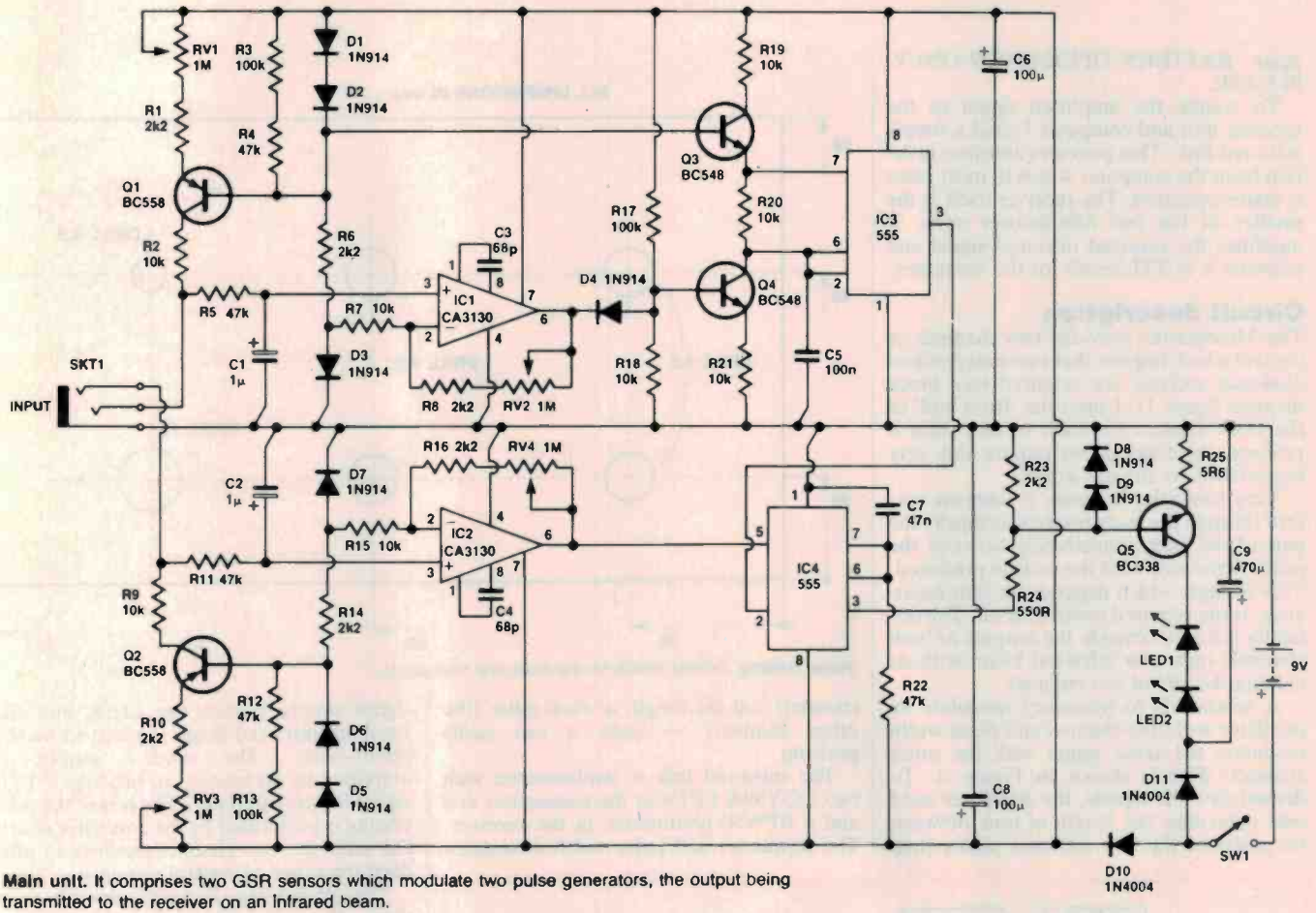
The range of applications for the Mindmaster includes hands free computer control, stress monitoring, relaxation aid, 'lie detector', etc. Each application will require its own type of probes and so this part will be left up to individual constructors. Some suggestions though, a headband with metal probes attached can be used for biofeedback applications; for faster control, a couple of metal rods held in the hands can be squeezed and released to appear like pressure sensors; metal probes can be taped to the fingers for lie detection — the list is endless.

Safety requirements

The Mindmaster is comprised of two units. The larger unit contains the sensor and transmitter electronics and must be powered by batteries. This is a safety requirement — under NO circumstances should the unit be powered by any mains operated power supply, no matter how safe it may appear. This is to eliminate any possibility of mains leakage or a power supply fault passing lethal currents through the body (we like to keep our readers). So once



Receiver. ZD1 is only used if the supply is over 5 V.



Main unit. It comprises two GSR sensors which modulate two pulse generators, the output being transmitted to the receiver on an infrared beam.

HOW IT WORKS — ETI-683

Mindmaster receiver unit

The encoded infra-red signal from the main unit is detected by IRD1, an infrared photodiode. The signal appears as a pulsed voltage across R1. This is fed into the inverting input of IC1 which amplifies the signal by a factor of 100 (actual gain = −(R5/R2)). To eliminate high frequency oscillations, capacitor C2 is placed in the freedback loop. Its value of 1pF is nominal and may have to be adjusted if your circuit is unstable. Use the lowest value which will stop oscillations without affecting the signal.

The final stage is a comparator which squares up the received signal and converts it to correct TTL levels. It compares the signal to a fixed dc level set by the voltage divider formed by R6, R7 and RV1. If the signal is below this voltage, the output of IC2 will be high; if the signal is above the voltage, the output will be low. Zener diode ZD1 is only used when the supply voltage is greater than 5 volts. It clamps the output voltage to 5 volts so as not to exceed TTL levels. The output voltage when clamped is:

V_{zener} — 1.2 V (2 diode voltage drops inside IC2)

and equals 5 volts in the present case.

Mindmaster main unit

As explained in the general text, this project is based on the ETI-546 GSR Moniter. Its analogue section is duplicated to provide the two front ends required for the Mindmaster. Since both are identical, I'll only describe the operation of one.

The basic idea behind the operation of the probes is to pass a constant current between them (i.e: between either probe and the 0 volt probe). This produces a voltage which is proportional to skin resistance (remember Ohms Law!!) which is fed to the input of IC1 (or IC2 for channel 2). The op-amp amplifies the voltage with reference to the 0.6 volt drop across D3 (D4) and the gain can be varied with RV2 (RV4).

But since skin resistance can vary over a large range, the actual value of current sent through the probes must also be adjustable to provide greater flexibility. This is provided by RV1 (RV2) which give a coarse level control. If for any reason a fine level control is also required, simply replace R4 (and R12) with 47K linear pots. In this case, connect the wiper to the transistor base, the "minimum" end of travel to R3 (R13) and the other end to the junction of D2 and R6 (D6 and R14). The original GSR monitor includes this control but it isn't really necessary in the present case.

The next section is the modulation circuitry which performs the analogue to pulse train conversion. While reading the following description, keep in the back of your . . . errr . . . MIND (sorry for that) that one signal needs to frequency modulate an oscillator and the other should pulse width modulate this FM signal as mentioned in the general text. IC3 performs the frequency modulation. Its output is fed to IC4 which is connected as a monostable whose pulse width is varied by the output of IC2 (using the 555 timer's control input).

The frequency modulation process may not appear obvious. It is built around IC3 which is a 555 timer astable circuit. Q2 provides a constant current of about 60µA to C5 (just think of Q3 and R19 as a resistor in the standard 555 astable setup). Q4 and associated components actually "rob" the capacitor of some of its current under the control of IC1. This has the effect of lowering the astable's frequency of oscillation, exactly what we require.

The final section of the main unit is the infra-red transmitter. This is simply a transistor which switches the current to the infra-red LEDs between two values — zero and approximately 100 mA. Diodes D10, 11 and capacitor C9 decouple the higher-current transmitting section from the lower-current sensor section.

again, BATTERY OPERATION ONLY, PLEASE.

To couple the amplified signal to the receiver unit and computer I used a simple infra-red link. This provides absolute isolation from the computer which in most cases is mains operated. The receiver itself is the smaller of the two Mindmaster units. It amplifies the received infra-red signal and converts it to TTL levels for the computer.

Circuit description

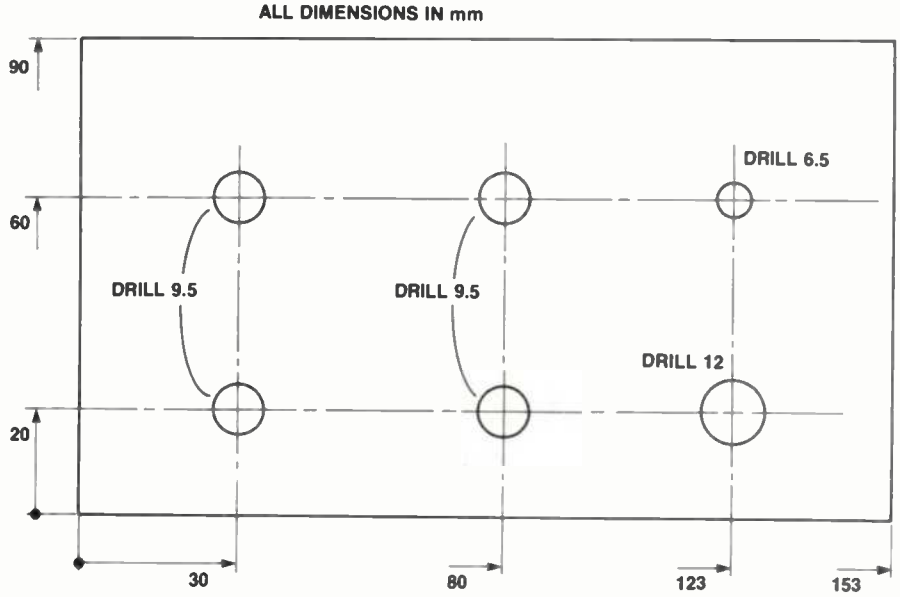
The Mindmaster provides two channels of control which implies that two independent analogue sections are required (see block diagram figure 1). I used the 'front end' of the GSR monitor for each section since it performs the exact job we require and, very importantly, it already works.

Very basically, it passes a constant current through the body (more specifically the part of the body immediately between the probes) and amplifies the voltage produced. This voltage, which depends on skin resistance, is the required control signal. The difficulty is how to encode the outputs of both channels onto one infra-red beam without making the circuit too complex.

A solution is to frequency modulate an oscillator with one channel and pulse width modulate the same signal with the other channel. This is shown in Figure 2. To demodulate the signals, the computer need only determine the length of time between the starts of the two adjacent pulses (one channel) and the length of each pulse (the other channel) — tasks it can easily perform.

The infra-red link is implemented with two CQY89A LEDs at the transmitter end and a BPW50 photodiode in the receiver. The frequency and pulse width modulated signal simply flashes the LEDs and the resultant infra-red beam is received by the photo-diode. The diode's output is amplified by an op-amp to produce a TTL signal for the computer. The rest of the processing is performed by the computer which can scale the two channel readings to produce the range of control required.

The processing however doesn't stop there. If your computer supports graphics or better still, colour graphics, then the possibilities are truly endless. Imagine monitoring your level of stress by watching colour changes on the screen or having two people trying to 'pull' a spot of colour across to their side of the screen using probes attached to their heads.



Panel drilling. Drilling details for the main unit front panel.

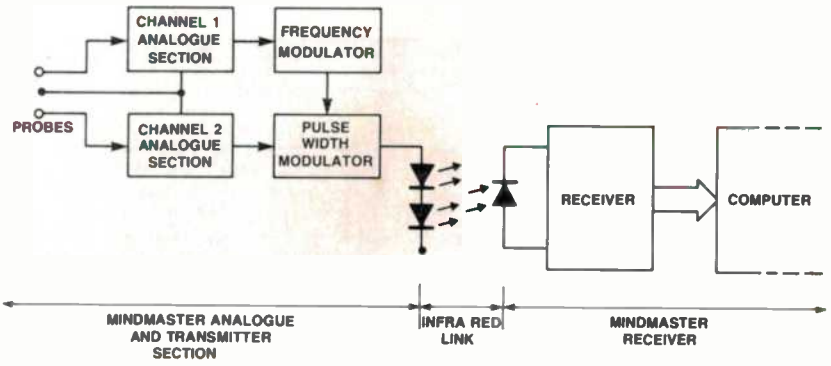


Figure 1. Mindmaster Block diagram.

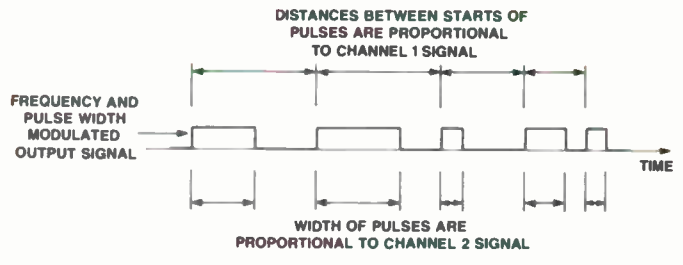


Figure 2. Details of Mindmaster's composite output signal.

Construction-main unit

Construction should present few problems if care is taken. Assemble in the following order — wire links, resistors, diodes, capacitors, transistors and ICs. IC sockets are not required unless you have doubts about your soldering ability. As always, check the orientation of all polarised components (electros and semiconductors). The only part to watch on the main board is the connection of R4 and R12 and their corresponding wire links. Mount the resistors upright so that the adjacent wire link can be soldered to one of the legs. As explained in the How-it-works, the original GSR Monitor used a fine level control which is not required in this project and so is replaced by the components just mentioned.

I mounted the circuit board in a standard 150 x 90 x 50 mm zippy box available from most electronic suppliers. The lid holds the controls, input socket and power switch. To drill the appropriate holes use the front panel artwork as a template and mark the hole centres. After drilling, carefully stick

PARTS LIST — ETI 683
Mindmaster main unit

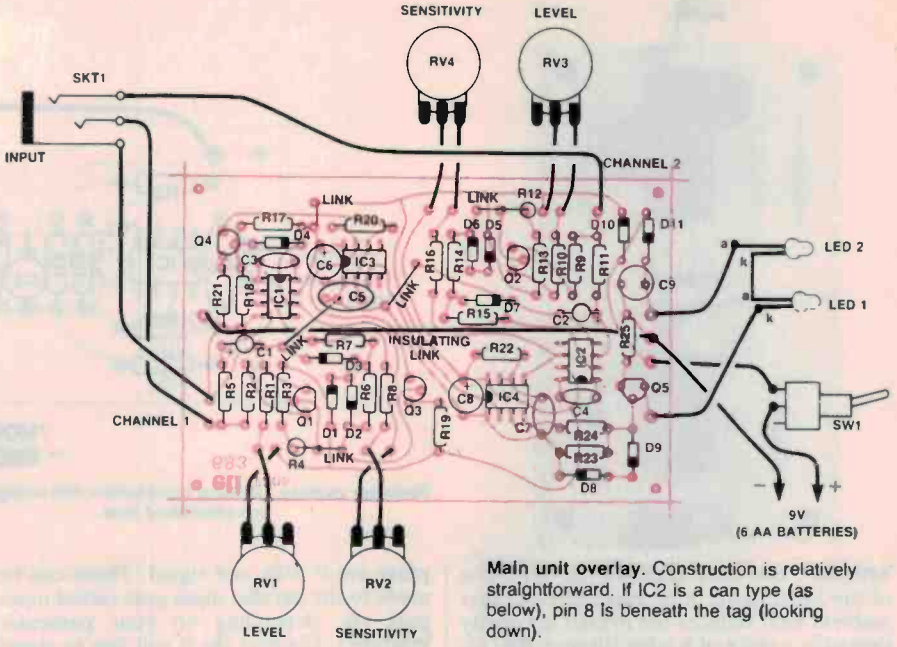
Resistors (all ¼W 5%)
- R1, R6, R8, R10, R14, R16, R23 ..... 2k2
- R2, R7, R9, R15, R19, R20, R21 ..... 10k
- R3, R13, R17, R18 ..... 100k
- R4, R5, R11, R12, R22 ..... 47k
- R24 ..... 560R
- R25 ..... 470R
- RV1-RV4 ..... 1M log pot

Capacitors
- C1, C2 ..... 1µ, tant. tag
- C3, C4 ..... 68p, ceramic
- C5 ..... 100n polyester
- C6, C8 ..... 100µ, 16V electro (pc mount)
- C7 ..... 47n polyester
- C9 ..... 470µ, 16V electro (pc mount)

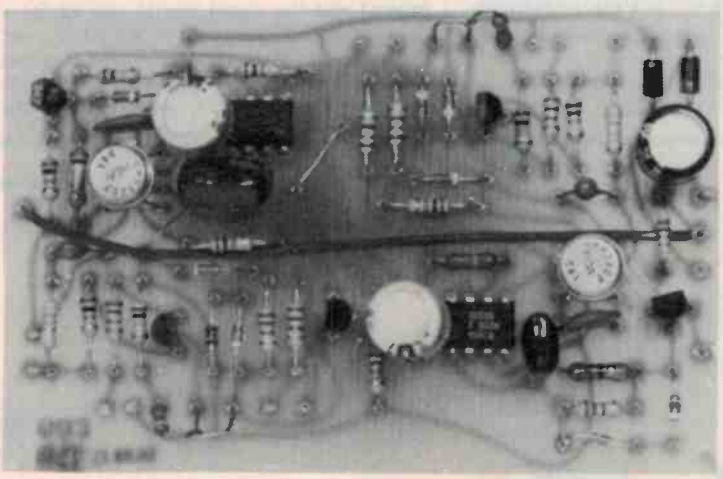
Semiconductors
- D1-D9 ..... 1N914 diode
- D10, D11 ..... 1N4004
- LED1, LED2 ..... CQY89A infra-red LED
- IC1, IC2 ..... CA3130 op-amp
- IC3, IC4 ..... 555 timer
- Q1, Q2 ..... BC557, or similar
- Q3, Q4 ..... BC547, or similar
- Q5 ..... BC338 transistor

Miscellaneous
- SKT1 ..... stereo 6.5mm socket
- PL1 ..... stereo 6.5mm plug
- SW1 ..... SPST sub-miniature toggle switch

ETI-683 trans pc board and Scotchcal label; 150 x 90 x 50 mm zippy box; 4 knobs; 6 aa battery holder; 9 V battery clip; hookup wire, nuts, bolts, etc.



Main unit overlay. Construction is relatively straightforward. If IC2 is a can type (as below), pin 8 is beneath the tag (looking down).



the Scotchcal label into place and mount the front panel controls. These can now be wired back to the pc board with standard hookup wire (refer to the wiring diagram).

Drill two 5 mm holes in one end of the plastic case and push the IR LEDs into place. A touch of glue may help here. Wire them to the pc board but, as mentioned before, check their orientation first. This completes construction of the main unit.

Construction — receiver

The Mindmaster receiver is the smaller of the two units and also the simplest to assemble. Once again, use the recommended pc board and take the usual precautions when mounting components. The BPW50 photodiode should be mounted last and its orientation carefully checked. The component drawings included with the wiring diagram should be referred to. When the photodiode is correctly mounted, its sensitive area is the side facing AWAY from the board.

Any type of case can be used to house the electronics. For the prototype I used an 83 x 54 x 28 mm zippy box but a 130 x 68 x 41 mm may be more suitable for your particular application. This will depend on whether or not your computer outputs a dc supply voltage for powering peripheral devices. If it doesn't then the larger box is required so that a 9 volt battery can be incorporated. Since the prototype Mindmaster was intended for the lab Microbee, there was no problem. The Microbee has a 5 volt dc output which I used to power the receiver.

Zener diode ZD1 is required only if a supply voltage of more than 5 volts is used. Its function is to clamp the output voltage to a maximum of 5 volts. This is to provide correct TTL levels for the computer input. The zener is not required if the receiver is powered from a 5 volt supply such as the Microbee's dc output.

After selecting a suitable case, drill a 5 mm hole in one end and four 3 mm holes in the bottom. Next, mount the board on 4 bolts and space it off the bottom by the thickness of two nuts. It should now be possible to bend the legs of the photodiode slightly to position its sensitive side flush

PARTS LIST — ETI-683
Mindmaster receiver unit

Resistors (all ¼W 5%)
- R1 ..... 15k
- R2 ..... 10k
- R3, R4 ..... 100k
- R5 ..... 1M
- R6, R7 ..... 270k
- RV1 ..... 10k trimpot

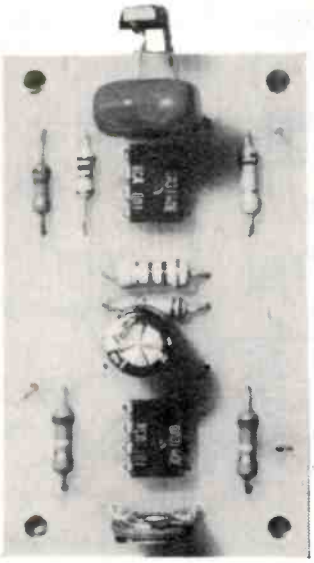
Capacitors
- C1 ..... 100n polyester
- C2 ..... 1p ceramic
- C3 ..... 100µ electro

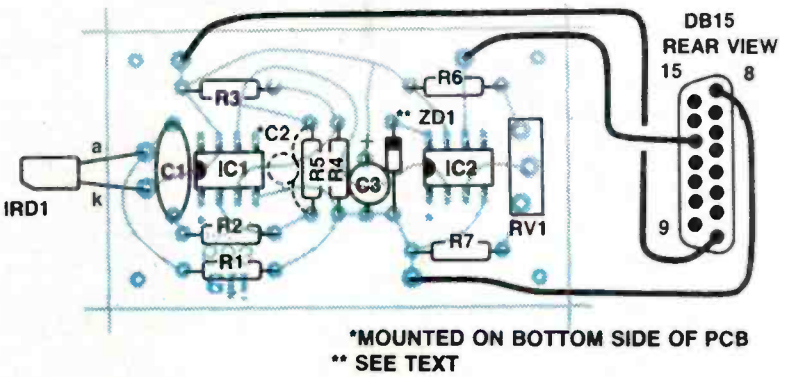
Semiconductors
- IC1, IC2 ..... CA3140
- IRD1 ..... BPW50 photodiode
- ZD1 ..... 6v2, 1W zener (not required for microbee — see text)

Miscellaneous

ETI-683rec pc board; Scotchcal label; 83 x 54 x 28 mm zippy box (see text); nuts, bolts, etc.

Price estimate **$30 — $35**





Receiver overlay. Showing construction and wiring of the receiver unit. The sensitive side of IRD1 is the non-chamfered face.

with the 5 mm hole. If during the operation of the Mindmaster it becomes obvious that ambient light reduces the overall sensitivity then glue a piece of Kodak Wratten 89C filter between the hole and the photodiode. This filter passes infrared light and attenuates the amount of visible light.

Having established the receiver's power supply, the final connections to the computer are 0 volts and signal. These can be made to the parallel input port (serial input port etc, depending on your particular machine). Connect the 0 volt line to signal ground and the signal line to one of the 8 data input connections. For simplicity, use the least significant bit, D0. Figure 3 shows the connection for a Microbee. For other computers, refer to the user's manual for the appropriate pin connections. Note that no plug has been specified in the parts list. Just buy the one which matches your computer.

Trimpot RV1 in the receiver should be adjusted to half way. It shouldn't need further adjustment unless the receiver is a bit far from the transmitter and noise pickup needs to be reduced.

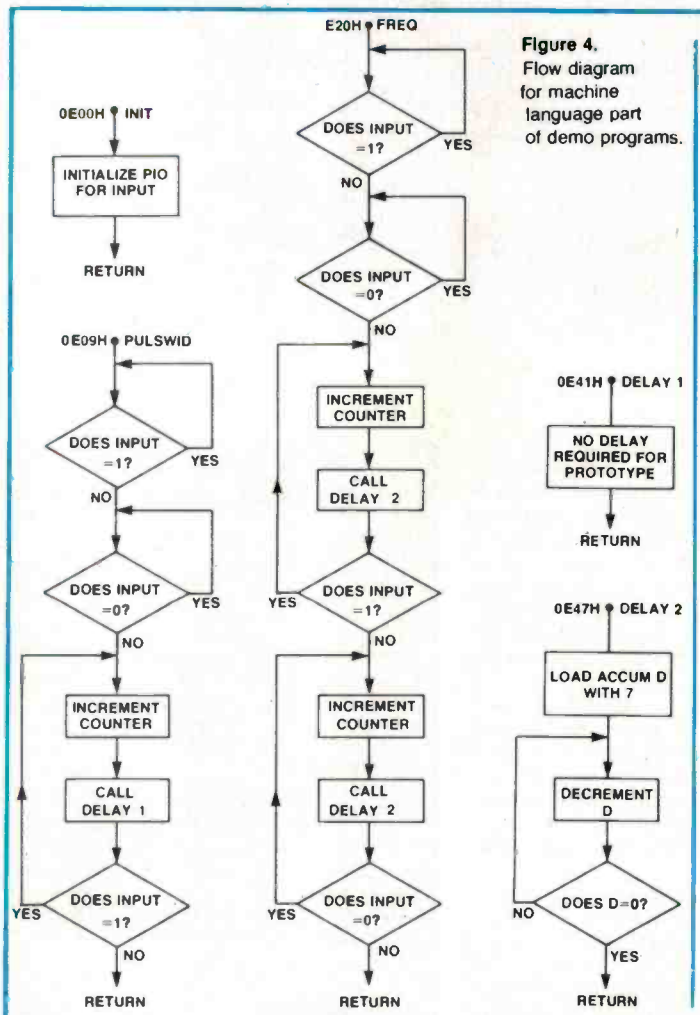
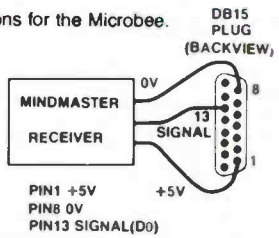


Figure 4. Flow diagram for machine language part of demo programs.

Figure 3. Receiver connections for the Microbee.



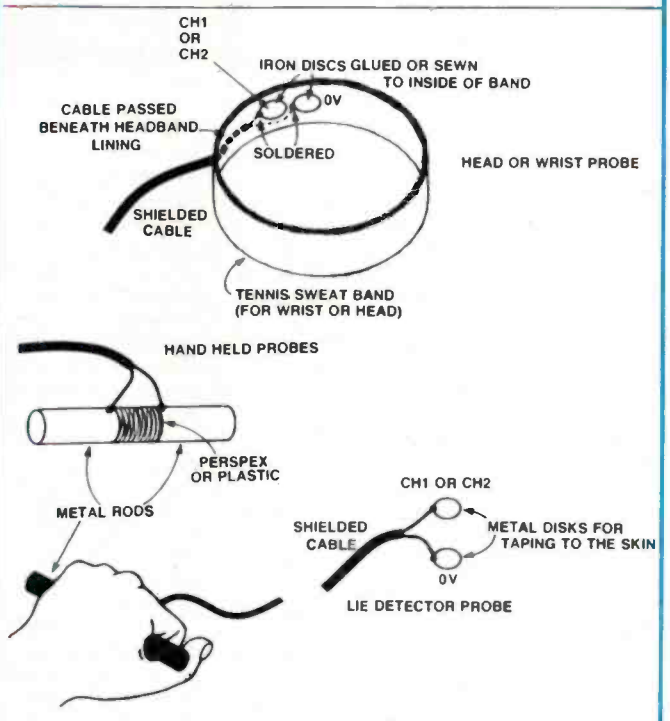


Figure 5. Probe construction.

PROGRAM LISTINGS

```
                        ORG 0E00

                ;INITIALISE PIO

0E00    3E CF           LD      A,0CFH          ;SET FOR CONTROL
0E02    D3 01           OUT     (1),A
0E04    3E FF           LD      A,00            ;DDR 11111111
0E06    D3 01           OUT     (1),A
0E08    C9              RET                     ;return

                ;DETERMINE PULSE WIDTH

0E09    DB 00   PULSWID IN      A,(0)           ;GET THE INPUT
0E0B    CB 47           BIT     0,A             ;TEST LS BIT
0E0D    20 FA           JR      NZ,PULSWID      ;LOOP IF = 1
0E0F    DB 00   LOOP1   IN      A,(0)           ;GET INPUT AND
0E11    CB 47           BIT     0,A             ;TEST IF = 0
0E13    28 FA           JR      Z,LOOP1         ;LOOP IF YES
0E15    DB 00   LOOP2   IN      A,(0)           ;VALID INPUT
0E17    0C              INC     C               ;INCREMENT COUNTER
0E18    CD 41 0E        CALL    DELAY1
0E1B    CB 47           BIT     0,A             ;INPUT STILL THERE?
0E1D    20 F6           JR      NZ,LOOP2        ;YES, SO LOOP AGAIN
0E1F    C9              RET

                ;DETERMINE PERIOD

0E20    DB 00   FREQ    IN      A,(0)           ;THIS SECTION IS
0E22    CB 47           BIT     0,A             ;THE SAME AS THAT
0E24    20 FA           JR      NZ,FREQ         ;FOR PULSWID
0E26    DB 00   LOOP3   IN      A,(0)
0E28    CB 47           BIT     0,A
0E2A    28 FA           JR      Z,LOOP3
0E2C    DB 00   LOOP4   IN      A,(0)
0E2E    0C              INC     C
0E2F    CD 47 0E        CALL    DELAY2          ;CALL DELAY2
0E32    CB 47           BIT     0,A
0E34    20 F6           JR      NZ,LOOP4
0E36    DB 00   LOOP5   IN      A,(0)
0E38    0C              INC     C               ;INCREMENT COUNTER
0E39    CD 47 0E        CALL    DELAY2          ;UNTIL NEXT PULSE
0E3C    CB 47           BIT     0,A             ;APPEARS
0E3E    28 F6           JR      Z,LOOP5
0E40    C9              RET                     ;RETURN

                ;DELAY1 SUBROUTINE

0E41    C9      DELAY1  RET                     ;DELAY NOT REQUIRED
0E42    00              NOP                     ;FOR PROTOTYPE
0E43    00              NOP
0E44    00              NOP
0E45    00              NOP
0E46    00              NOP

                ;DELAY2 SUBROUTINE

0E47    16 07   DELAY2  LD      D,7
0E49    15      LOOP6   DEC     D
0E4A    20 FD           JR      NZ,LOOP6
0E4C    C9              RET                     ;RETURN
```

```
00100 REM               ETI-683 MINDMASTER
00110 REM               DEMONSTRATION PROGRAM No 1
00120 CLS:HIRES
00130 GOSUB 230: REM INITIALISE PIO
00140 K=0: L=0
00150 FOR I=1 TO 10: REM GET AVERAGE OF 10 READINGS
00160 K=K + USR(3593)
00170 L=L + USR(3616)
00180 NEXT I
00190 K=K / 10
00200 L=L / 10
00210 PRINT K,L
00220 GOTO 140
00230 REM MACHINE CODE LOADER ROUTINE
00240 REM POKES SUBROUTINES TO 0E00H
00250 REM REFER TO LISTING GIVEN ELSEWHERE
00260 FOR A=3584 TO 3660
00270 READ B
00280 POKE A,B
00290 NEXT A
00300 DATA 62,207,211,1,62,255,211,1,201
00310 DATA 219,0,203,71,32,250,219,0,203,71,40,250,219,0
00320 DATA 12,205,65,14,203,71,32,246,201
00330 DATA 219,0,203,71,32,250,219,0,203,71,40,250,219,0
00340 DATA 12,205,71,14,203,71,32,246,219,0,12,205,71,14
00350 DATA 203,71,40,246,201
00360 DATA 201,0,0,0,0,0
00370 DATA 22,7,21,32,253,201
00380 REM INITIALISE PIO
00390 X = USR(3584)
00400 RETURN
```

```
00100 REM               ETI-683 MINDMASTER
00110 REM               DEMONSTRATION PROGRAM No 2
00120 CLS:HIRES
00130 SET 0,0
00140 P=0: Q=0
00150 GOSUB 270: REM INITIALISE PIO
00160 K=0: L=0
00170 FOR I=1 TO 10: REM GET AVERAGE OF 10 READINGS
00180 K=K + USR(3593)
00190 L=L + USR(3616)
00200 NEXT I
00210 K=K / 10
00220 L=L / 10
00230 RESET P,Q: REM RESET PREVIOUSLY PLOTTED POINT
00240 SET K,L: REM PLOT POINT IN HIRES
00250 P=K: Q=L: REMEMBER CURRENT POINT
00260 GOTO 160
00270 REM MACHINE CODE LOADER ROUTINE
00280 REM POKES SUBROUTINES TO 0E00H
00290 REM REFER TO LISTING GIVEN ELSEWHERE
00300 FOR A=3584 TO 3660
00310 READ B
00320 POKE A,B
00330 NEXT A
00340 DATA 62,207,211,1,62,255,211,1,201
00350 DATA 219,0,203,71,32,250,219,0,203,71,40,250,219,0
00360 DATA 12,205,65,14,203,71,32,246,201
00370 DATA 219,0,203,71,32,250,219,0,203,71,40,250,219,0
00380 DATA 12,205,71,14,203,71,32,246,219,0,12,205,71,14
00390 DATA 203,71,40,246,201
00400 DATA 201,0,0,0,0,0
00410 DATA 22,7,21,32,253,201
00420 REM INITIALISE PIO
00430 X = USR(3584)
00440 RETURN
```

At last, the moment of truth. Connect the 6 AA battery holder to the main unit (with batteries in it, of course), place it carefully inside and screw the lid back on. Make up a simple probe by connecting three lengths of hookup wire to a stereo 6.5 mm jack. Next, plug the receiver into your Microbee (or whatever) and enter demonstation program number 1. Note that the demo programs may have to be changed to suit your computer if it's not a Microbee. Type RUN and switch the main unit on. Set it up about 300 mm from the receiver pointing the IR LEDs towards the photodiode (of course!!).

Two columns of numbers will appear on the screen unless you mis-typed the program. The numbers represent the decimal equivalent of the resistance between each probe and zero volts. Since the probe connections are open, the values displayed are the maximum available. If you now short a probe to 0 volts, the corresponding reading will drop to some low value. This is the minimum value available with the current program. The total range of values should vary from about 1-50 to around 150-255. The absolute maximum is 255 which, if exceeded, will 'wrap around' and start from 0 again (in other words 256 = 0, 257 = 1, etc). If this occurs with your system, then either the transmitter pulse is too wide or the frequency is too low. This can be fixed by changing the delays in the machine language routines.

Obviously any values read by your computer can be scaled to cover the range required for your particular application so don't worry if these differ from the range given previously.

If all is well, the Mindmaster is ready to use. I have written another simple demo program which plots a hires-point under the control of the probes. Two people can be 'wired up' to move the point in 2 dimensions. To set the controls, first attach the probes, set SENSITIVITY to minimum and advance LEVEL until a mid-range reading is produced. The rest is up to you.

Tips

1) The flow diagram for the machine language part of the demonstration programs is shown in Figure 4. This can be modified as required.

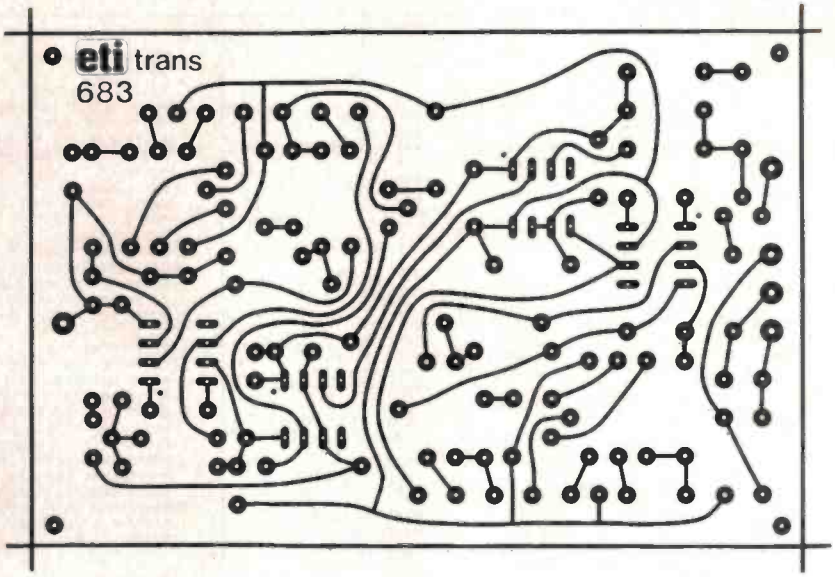
2) Figure 5 shows some ideas for the construction of probes. For biofeedback applications, head or wrist band probes are ideal and simply require connections to metal discs which are glued to the inside of a tennis sweat band. The cable can be passed through the centre of the material to exit at some convenient point.

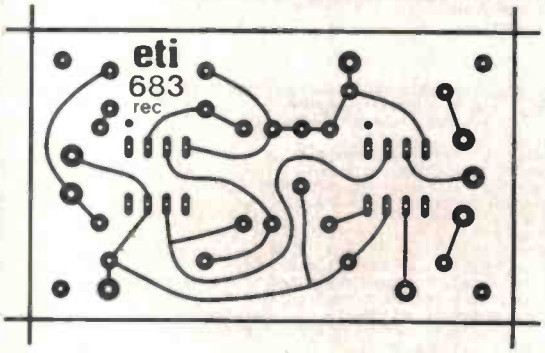
For much faster control, rod-type probes can be made. These can be hand-held and squeezed to change skin resistance. For lie detector applications, small metal discs can be taped to the arms, forehead, etc. As always, it's up to the imagination.

3) Tests on the prototype gave the following results: single channel control, one person — excellent control; two channel control, ▶

two people — very good control, very slight interaction between channels; two channel control, one person — very good control but much interaction. Correct adjustment of controls will reduce this (the interaction is due to the currents from each probe not being isolated from each other as they pass through the body). Two zero volt probe connections can be implemented to help reduce interaction further.

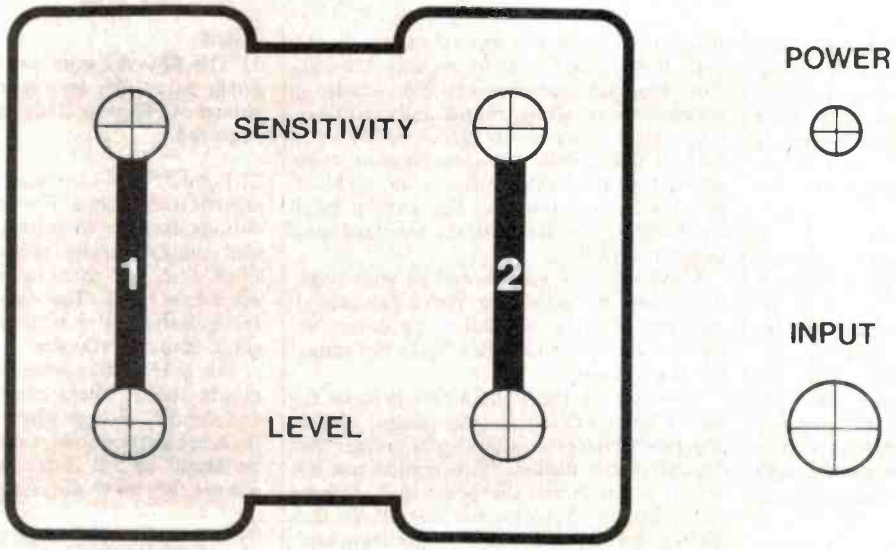
4) The range of the transmitter can be increased by dimming the room lights, using a piece of Kodak Wratten 89C filter in front of the photodiode, or fitting a tube in the photodiode's mounting hole to reduce ambient light pickup. Note that this requires greater alignment of transmitter and receiver. ●

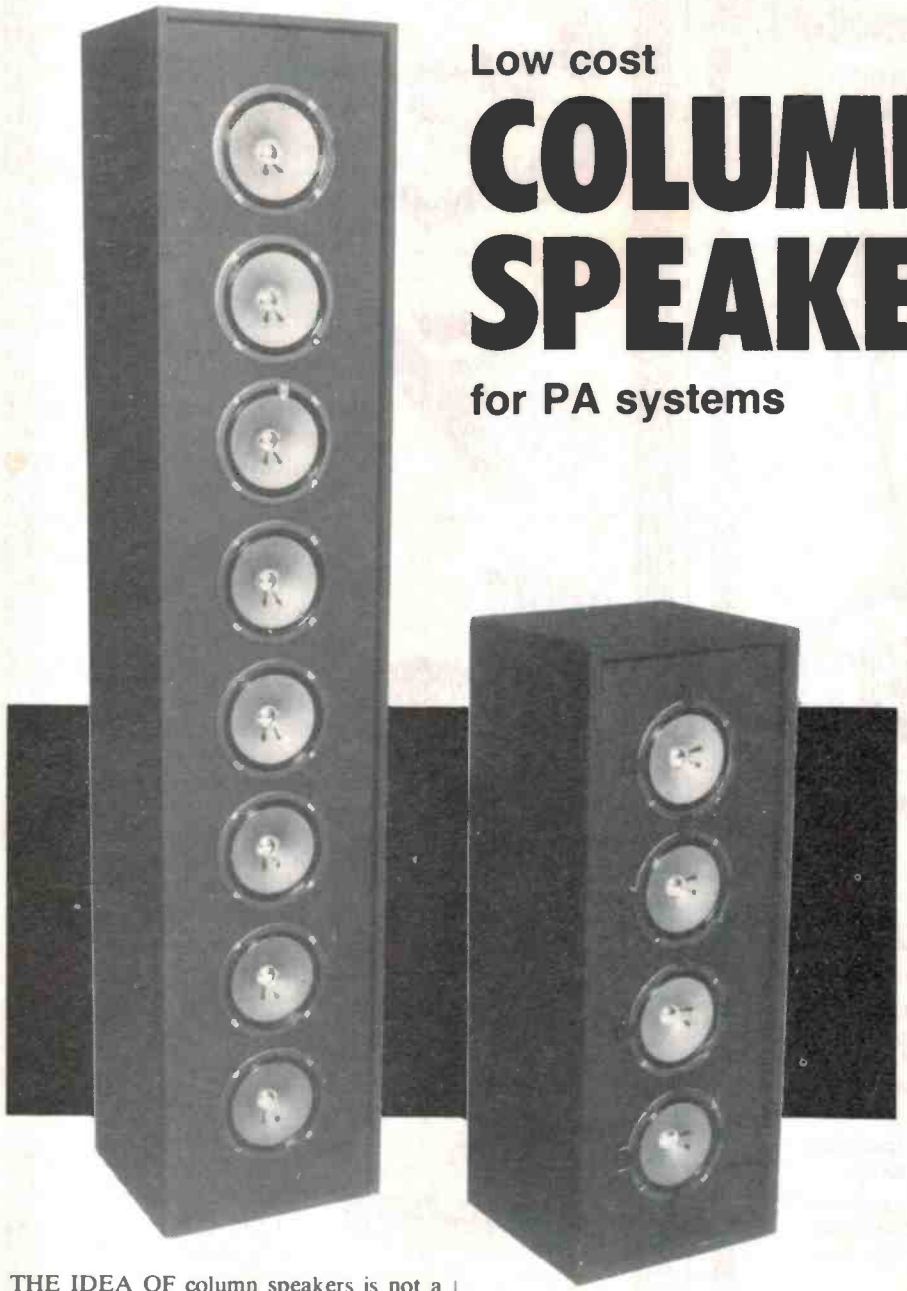




eti 683 'MINDMASTER' receiver

eti 683 'MINDMASTER'





Low cost

COLUMN SPEAKERS

for PA systems

THE IDEA OF column speakers is not a new one. Its history dates back as far as the old RCA Photophone sound/motion picture theatre installations which first opened in 1928. In these installations, the speakers were housed in individual enclosures which were then placed on top of each other to form the column. Since then the column speaker has become the most popular form of sound reinforcement used in lecture theatres, indoor sports stadiums and meeting halls.

A column basically consists of several direct-radiator loudspeakers mounted one above the other. The purpose of this design is to confine the sound distribution pattern to a fan shaped wedge with wide horizontal and narrow vertical sound distribution. The advantage of this in an auditorium situation is that the sound can be directed at the audience with a minimum of sound being directed at the ceiling and back wall. In halls with accoustically 'live' ceilings or walls, reflected sound waves from these surfaces can cause many problems. Reflected waves from a wall or ceiling can cause interference with the direct sound from the loudspeaker and thus cause the sound to be muffled and incoherent. Also the problem of feedback can be exaggerated when there is a large amount of reflection from a back wall. Column speakers may not completely cure these problems but they will allow anyone installing a sound reinforcement system to minimise any potential problems.

Column speaker design

The aim when designing column speakers is to minimise the vertical distribution of sound from the speaker. The two main parameters which affect this are the length of the column and the distance between the individual speakers in the column. For the best performance the column should be as long as practical and the speakers mounted one above the other as close together as possible. The obvious restriction here is the longer the column, the greater the number of speakers needed, so quite often, the choice of the length of the column will be decided by how many speakers you can afford to buy. The speakers normally used are either 6" (150 mm) or 8" (225 mm) diameter. This is generally because using much bigger speakers the columns could become a little cumbersome to handle. You can imagine the size of a 16 speaker column using 12" speakers (try mounting that on your wall!).

Most column speakers are of a sealed enclosure design although there are many exceptions to this. Usually venting or porting is not required in PA column applications since porting an enclosure is done to augment the bass response of the speaker and this is not usually a critical requirement where speech amplification is concerned. The simplest columns, therefore, consist basically of a long sealed box with a number of speakers mounted in a line in the front. Starting from this basic idea, several methods of improving the directional efficiency of columns have been tried over the years.

To improve the directional properties of the column, a slight concave bend can be put in the face of the column so that all the speakers face into a focus point on the central axis of the column. This method can achieve excellent vertical compression of the response pattern but the woodwork can often be quite a problem for people without access to woodworking machinery.

A second method of improving the directional response is known as acoustical tapering. This essentially involves the use of wedges of sound absorbent material to attenuate the sound from the outer speakers. The attenuation is tapered to zero at

the centre of the column. The sound absorbent material is usually some form of fibreglass foam. This will attenuate the high frequencies coming from the speakers and the amount of attentuation is proportional to the thickness of the fibreglass. Although the woodwork is straightforward in these designs the cutting of the fibreglass into wedges can be a problem for the average handyman. Fibreglass dust can also be quite dangerous if inhaled or touched so for home constructors an alternative absorbent material should be used.

One simple method to improve the response of a column is to use a combination of single cone and twin cone drivers. Twin cone speakers have an extended high frequency range and if they are used for the central speakers in a column and single cones are used for the outer speakers the effect will be similar to that of acoustical tapering since the high frequencies will be attenuated towards the outer edges of the column. This also means that relatively cheap single cone speakers can be used as they will not need to cover any really high frequencies.

Construction of two columns

In the design of the two columns that follow the emphasis has been on simplicity and ease of construction. Both columns can be constructed from standard size pieces of chipboard with a minimum of cuts so even those with limited woodworking tools should be able to make up the boxes without any trouble. The only specialised tool that may be needed is a jigsaw to cut out the holes for the speakers. For those not lucky enough to own one of these then perhaps it's time you looked up a few old friends that do.

The first design to be discussed will be that of a small four-speaker column. This column stands 90 cm high and has four, 6" (150 mm) speakers housed in it and is ideal ▶

PARTS LIST — 1422

Four-speaker column

4 x 6" diameter speakers (see text)
2 sheets of 300 mm x 900 mm chipboard, 18 mm thick (13 mm thick can be substituted)
2 sheets 300 mm x 1200 mm chipboard, 18 mm (or 13 mm) thick
2 speaker input connectors
hookup wire, glue, nails, screws, acoustic stuffing

Optional: speaker grill, outdoor PVC based carpet (1 m^2, see text), 8 metal corner pieces

Eight-speaker column

8 x 6" diameter speakers (see text)
4 sheets of 300 mm x 1850 mm chipboard, 18 mm (or 13 mm) thick
2 speaker input connectors
hookup wire, glue, nails, screws, acoustic stuffing

Optional: as for 4 speaker column

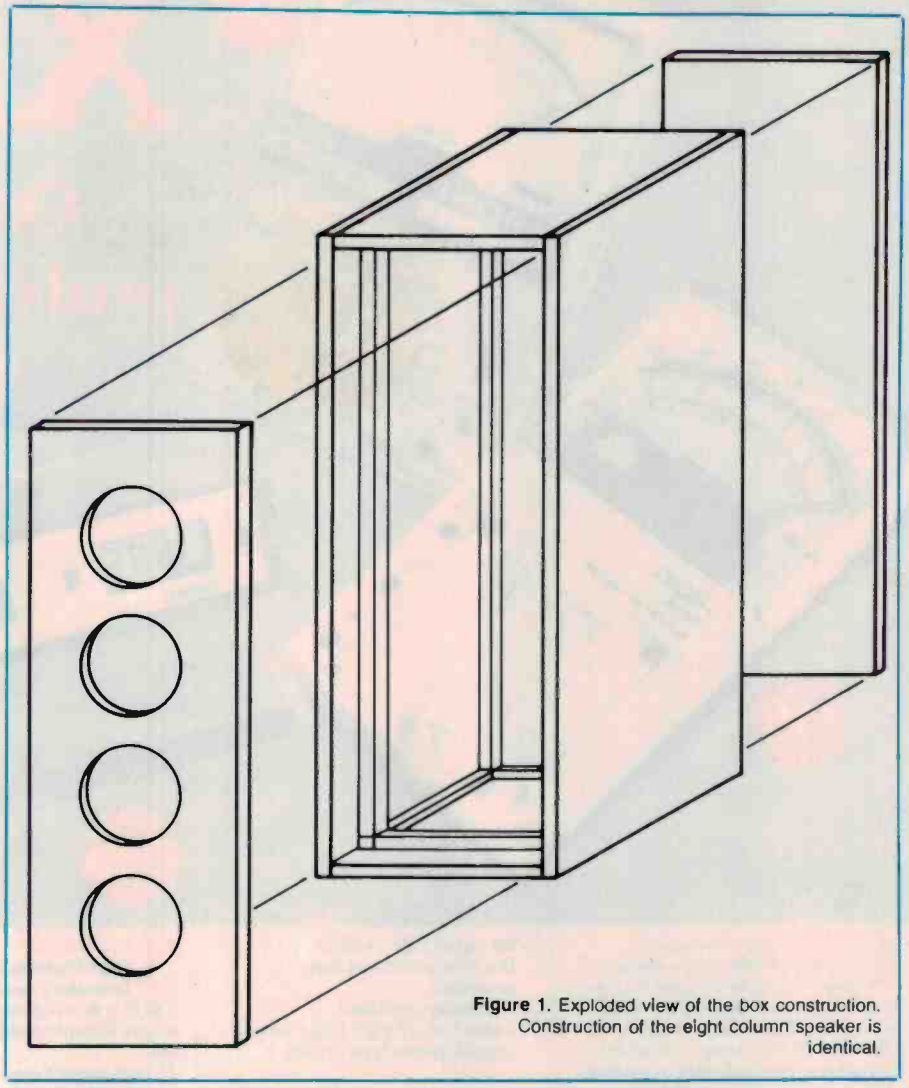


Figure 1. Exploded view of the box construction. Construction of the eight column speaker is identical.

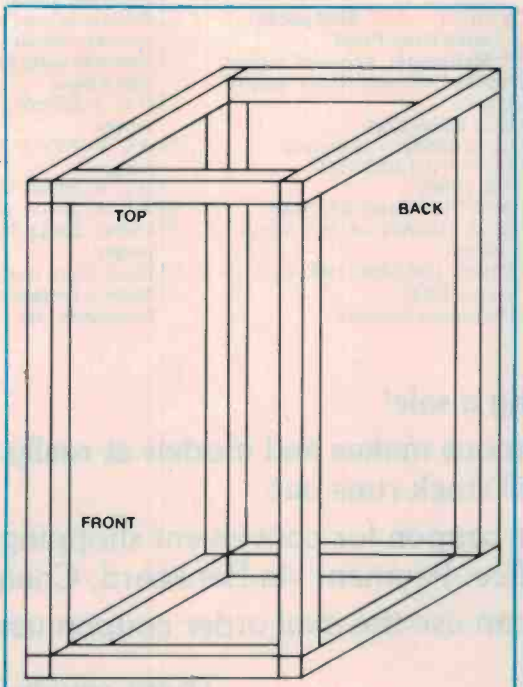


Figure 2. Diagram showing how the cleats are butted together inside the box.

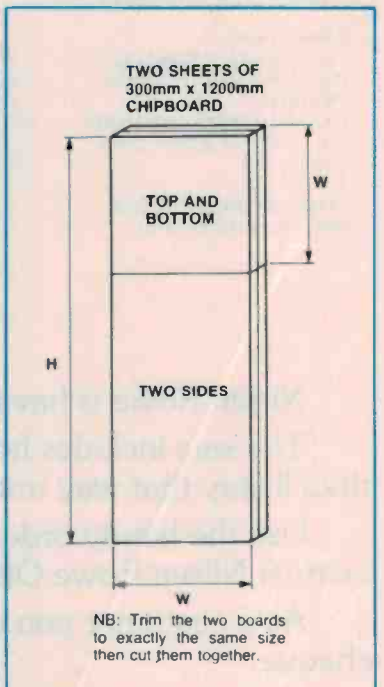


Figure 3. Cutting diagram for sides and top of column.

XMAS

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- ☐ D.C. A: 25/uA-2.5ma-25ma-250ma-10A.
- ☐ A.C. A: 10A.
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- ☐ Only 22mm thick.
- ☐ Up to 20K Ω/V Sensitivity.
- ☐ DC V: 0.3-3-10-30-100-300-1000V.
- ☐ AC V: 10-30-100-300-1000V.
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- ☐ Balanced carry handle doubles as bench-stand.
- ☐ D.C. V: 200mV-1000V in 5 ranges.
- ☐ A.C. V: 200mV-750V in 5 ranges.
- ☐ D.C. A: 200uA-10A in 6 ranges.
- ☐ A.C. A: 200uA-10A in 6 ranges.
- ☐ OHMS: 200Ω-20MΩ in 6 ranges.
- ☐ Diode check feature.
- ☐ Made in England by Sinclair Electronics Ltd.

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- ☐ DC A: 20uA-10A, Resolution 10nA, Manual ranging.
- ☐ AC A: 20uA-10A, Resolution 10nA, Manual ranging.
- ☐ OHMS: 200-20M Resolution 0.1 ohm, Autoranging.
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- ☐ AC A: 200mA-10A, Resolution 100uA, Manual ranging.
- ☐ OHMS: 200-2M, Resolution 0.1 ohm, Autoranging.
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for small halls or stadiums. No part of the construction is really critical but the dimensions given will allow the box to be cut from four sheets of chipboard with a minimum of cuts. There are quite a few variations from our prototype that are mentioned. The construction article is really meant as a guideline for you to 'roll-your-own' columns to suit whatever application you have in mind.

The first thing to do is to obtain the suitable sizes of chipboard. Hardware stores should sell 1′ x 3′ (300 x 900 mm) and 1′ x 4′ (300 x 1200 mm) sheets of chipboard as standard sizes. You will need two sheets of each. The exact size will vary depending on how accurately it is cut. When buying the chipboard try to get sheets that are all the same width. Even if they are marked as 300 mm wide the exact width can vary up to 10 mm between boards. Either 13 mm or 18 mm thick chipboard can be used. The prototype was built using 18 mm thick chipboard which gives a very rigid enclosure but 13 mm could be used to give a lighter weight box.

To cut the pieces of the box there is no need to cut exactly the sizes shown in the diagram. If the pieces of chipboard that you buy are a few millimetres longer than ours don't try to trim them to the exact size, just make the box slightly longer. The main thing to watch out for is to get all the corresponding pieces the same size i.e: make sure that the two sides are the same size and that the top and bottom pieces are the same. From a 1′ x 4′ sheet you will be able to get one side and a top or bottom piece exactly. The 1′ x 3′ pieces will give you the back and front pieces. These will have to be trimmed so that the top and bottom wil fit flush with the sides.

Firstly, cut the sides and top and bottom from the 1′ x 4′ lengths of chipboard and trim the edges so that all pieces are smooth and square. The top and bottom pieces should now be attached to one of the sides. For strength and to seal the joint it is recommended that the joints be glued and screwed. Whenever putting screws into chipboard it is a good idea to drill pilot holes first. This stops the wood from splitting. Also, the screws should be countersunk (remember, neatness counts!). The other side should now be attached. When this is done check that the box is square. If it is slightly askew then you should push it square and temporarily nail some pieces of wood across the corners to keep it square while the glue dries. Leave the box alone until the glue hardens.

The next step is to cut and mount the cleats. These are cut from lengths of 18 mm square timber. The diagram shows the positioning of the cleats for 18 mm thick chipboard. If you are using 13 mm chipboard then you will have to adjust the dimensions by 5 mm as appropriate. The front cleats should be positioned 20 mm plus thickness of chipboard back from the front edge and the back cleats should allow the back panel to fit in flush with the sides, i.e: they should be mounted the thickness of the chipboard back from the back edge. Once again, they should be glued and screwed for strength.

With the cleats in position, the front baffle can now be cut. Firstly, trim a sheet of 1′ x 3′ chipboard so that it fits neatly into the front of the box. Before mounting the front baffle carefully mark out the four holes for the speakers and cut them out (this is where your jigsaw comes in handy). Try to be accurate with your hole cutting because if you cut the holes too big you might find it difficult to screw in the speakers (like we did!). Once the baffle has been cut you can mount it. The baffle should be screwed to the cleats and glue run along all the edges to form an air tight seal.

Trim the other 1′ x 3′ sheet of chipboard to fit neatly into the back of the box and cut the holes to mount the speaker connectors. In the prototype two connectors were paralleled up so that boxes could be paralleled without the necessity of running all the wires back to the amp. Any type of speaker connector can be used but it is probably best to try to find one that doesn't stick out too much. If you want to mount the column flush against a wall then you can just drill a small hole and bring the speaker wire out directly. The back panel should be left off for the time being and the remainder of the box left to let the glue dry thoroughly.

While everything is drying it's probably a good time to think about what sort of finish you'd like on the columns. The cheapest and easiest thing to do is to simply paint the outside of the column. On the prototype we filled all the screw holes with a wood filler and then gave the whole box a few good coats of undercoat and finished off with a few coats of matt black enamel. When the speakers were mounted this gave quite a respectable finish and is all that is needed if the columns are to be mounted up on the walls of a hall. If, however, you like a more exotic finish to your columns, you can get a rubber based outdoor patio carpet from Clarke Rubber Stores which can be glued on to the outside of the column and makes an excellent finish as well as protecting the box itself. This carpet is used extensively in commercial PA equipment and gives a very professional look. The front baffle is usually not covered with carpet as this would make the speakers difficult to mount. It is best just to paint it black. Whether you paint or cover, it is recommended to put steel corner pieces on the column as you may quickly find that chipboard will start breaking away at the corners. If the columns are going to sit on a shelf or floor then it's a good idea to put on some screw-on rubber feet as well. The only thing left to consider in the finish area is a grill. I will discuss a couple of grill materials a little further on in the article.

The speakers

Having built the box it would be nice to have some speakers to go in. The box is a non-ported type and is not tuned for a particular speaker resonance, so the actual driver is a matter of choice. The things to look for when choosing a driver are its frequency range, impedance and price and you can order these in any priority you like. After searching through books and catalogues to find a variety of speakers with enticing frequency responses and depressing prices we decided that we would go the other way and choose some inexpensive speakers that did the job. A small hall may want to put in four columns requiring sixteen speakers in all; these would almost exclusively be used for sound reinforcement of speeches, hardly justifying the cost of expensive full range speakers. The ones we eventually chose were Pioneer 6″ (150 mm) car speakers. These were rated as 4 ohm, 10 watts and had a usable frequency range of about 150 Hz to 10 kHz which is quite adequate for speech. These can be bought for under $4 each from Jaycar (see Shop Around) making their use in columns attractive, and after building the column up the sound was found to be quite good. The only disadvantage was that the treble control on the amp had to be increased slightly to make the t's and s's cut through crisply, but I think in most cases this is preferable to paying four or five times the price for speakers. I'll have a further rave on drivers, particularly on mixing single cones and twin cones, at the end of the article so if you're

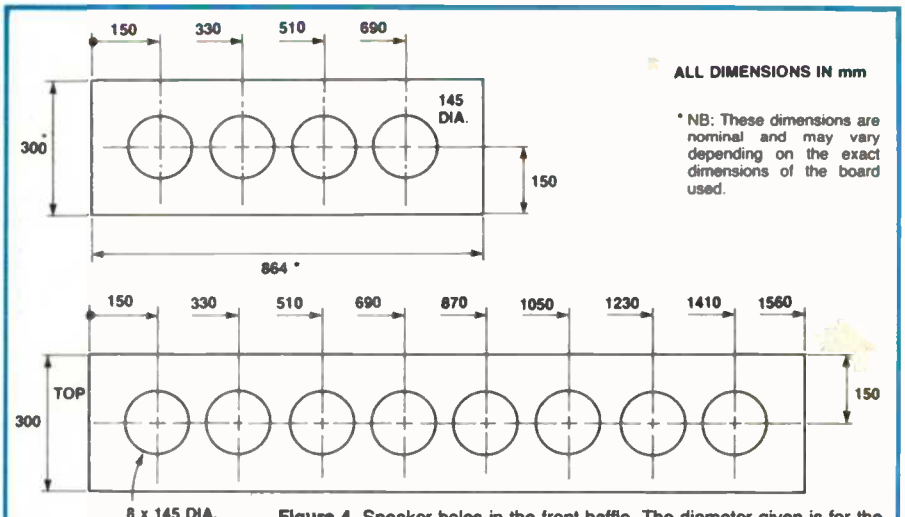


Figure 4. Speaker holes in the front baffle. The diameter given is for the speakers recommended in the text. If other speakers are used this may have to be adjusted slightly to suit.

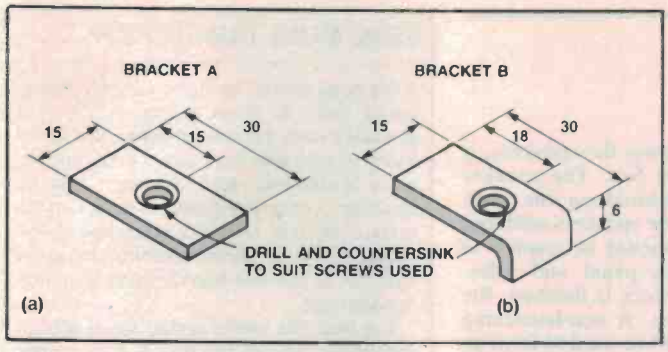


Figure 5 above. Shows (a) the dimensions for the brackets that fit in between the speakers; shows (b) details of the brackets for the outside of the speakers.

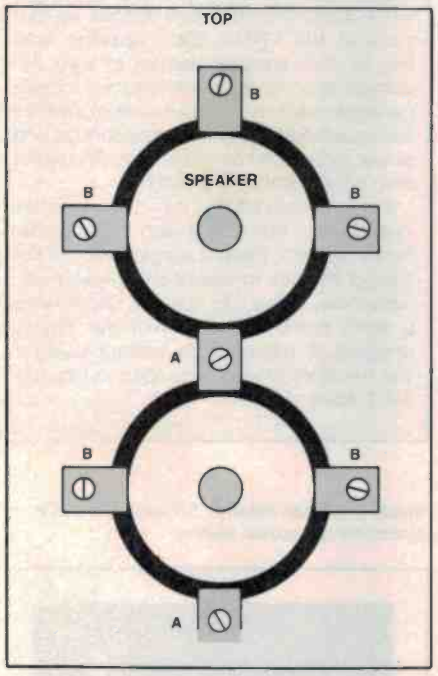
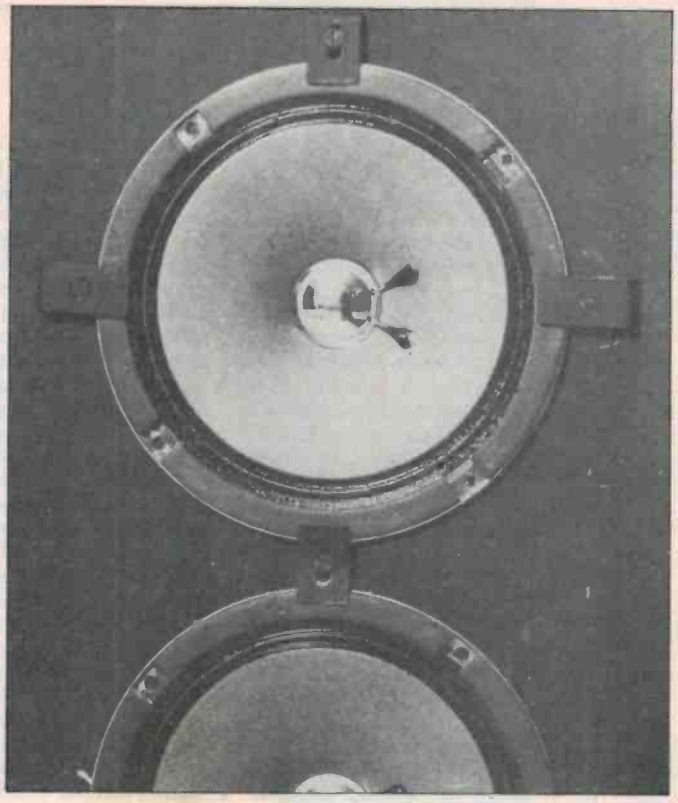


Figure 6 left. Placement of the two types of bracket for speaker mounting. See picture at right.



still in doubt as to what to do about drivers then maybe you'd better read that now.

Mounting and wiring the drivers

If you have done an accurate job on cutting out the holes for the speakers then you'll probably have no problem screwing the speakers to the baffle using the mounting holes provided on the speakers. If, however, like me you cut the holes too big then you may find that there is not enough wood left around the edge of the speaker to allow a screw to be put there. In this case you can make up some small metal brackets to hold the speakers in. A design for suitable brackets is given in Figure 5. You will notice that there are two types of bracket shown. Figure 5a shows the bracket which would be used in between speakers and would provide anchorage for two speakers at the same time. Three of these are necessary. Figure 5b shows the bracket which would be used around the outside of the speakers. Ten of these would be required. Before mounting the speakers make sure that all the painting and carpeting of the columns has been finished and has dried. The speakers can then be mounted in the appropriate manner.

Wiring of the speakers will depend on the impedance of the speakers used and the desired final input impedance. The desired impedance will depend on the drive capabil- ▶

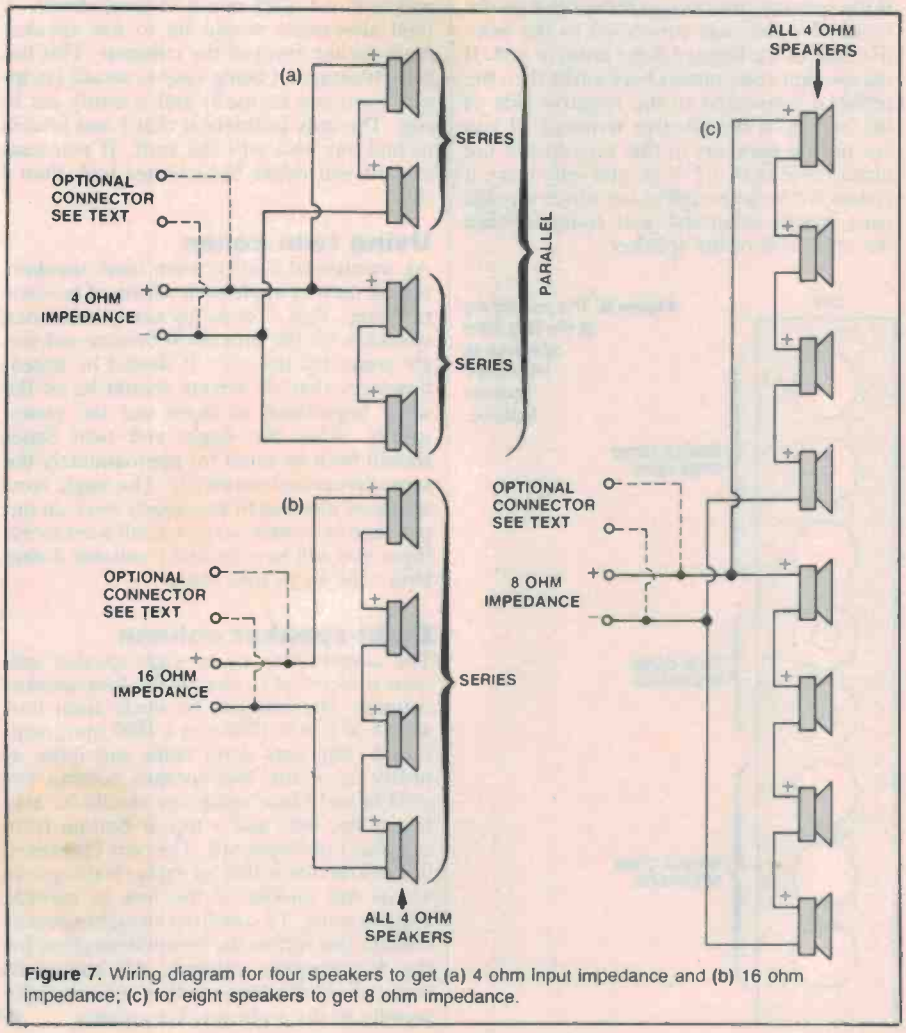


Figure 7. Wiring diagram for four speakers to get (a) 4 ohm input impedance and (b) 16 ohm impedance; (c) for eight speakers to get 8 ohm impedance.

ity of the amplifier and how many columns that you want to use. For example, if you have an amplifier that has a minimum load impedance of 4 ohms and you want to use four columns, then you would want each column to have an impedance of 16 ohms. Four of these columns driven in parallel would present a load impedance to the amplifier of 4 ohms which is what you want. The wiring diagrams for the four speaker column show how to obtain either a 4 ohm or 16 ohm impedance. If you are using 8 ohm speakers then the same wiring diagrams will give impedances of 8 ohms and 32 ohms respectively. If you are unsure about parallel and series impedances then any basic electronics book will tell you the ways to work out the resultant impedance. One thing to be careful of is making sure that the speakers are all wired up in phase with one another. Most speakers will have their terminals marked with a red dot, a plus sign or some other method for showing which terminal is the positive one. If your speakers don't have the positive terminal marked then you can find out by applying a small dc voltage to the speaker. A 1.5 V dry cell is ideal for this. Connect the battery momentarily across the speaker terminals. If the speaker cone moves forwards then the terminal which was connected to the positive side of the battery is the positive one. If the speaker cone moves backwards then the terminal connected to the negative side of the battery is the positive terminal. If you are testing speakers in this way do not use much more than 1.5 V dc and only leave it connected long enough to see which way the cone moves otherwise you could damage the voice coil of the speaker.

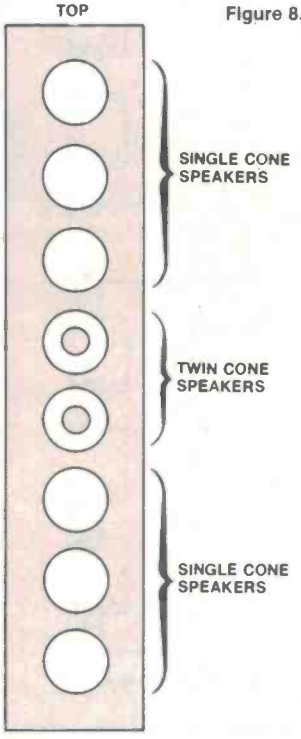


Figure 8. The positioning of the twin cone speakers to implement acoustic tapering.

Finishing off

After mounting and wiring the speakers, it is time to close up the box. The speaker sockets should be mounted on the back panel and the wire to the speakers soldered on. Acoustic stuffing should be stapled to the inside of the back panel and sides. When all the internal work is finished, the back can be screwed on. A non-hardening silicon compound should be used to form an airtight seal where the back panel sits on the cleats. Silastic is ideal for this. A total of six screws should be adequate to hold the back on securely. The only thing left to think about now is the grille.

For those of you who think that the columns look aesthetically pleasing with bare speakers on the front, the problem of a grille can be ignored. For the others there are several options open. Firstly, ordinary hi-fi speaker cloth can be mounted on a frame and used as a front cover. If the columns are going to be mounted in a place in which they are likely to be hit by objects such as flying basketballs, tennis balls, beer cans etc, then a mild steel mesh commonly used in professional PA speakers can be used. This mesh is known as 12-12-F (catchy name!) and can be bought from B&D Expamet in 8′ x 4′ (225 mm x 75 mm) sheets. A final alternative would be to use speaker foam for the front of the columns. This has the advantage of being easy to attach (strips of Velcro can be used) and is easily cut to size. The only problem is that I was unable to find out who sells the stuff. If you hunt around you might have better luck than I did.

Using twin cones

As mentioned earlier, twin cone speakers can be used to implement a form of acoustic tapering. This is done by using twin cone speakers for the innermost drivers and single cones for the rest. It should be noted, however, that all drivers should be of the same impedance to share out the power evenly. Also the single and twin cones should both be rated for approximately the same power and sensitivity. The single cone speakers mentioned previously have an impedance of 4 ohms, so if you still want to use these you will have to find a suitable 4 ohm twin cone to go with them.

Eight-speaker column

The construction of an eight-speaker column is identical to that of the four-speaker column. The box can be made from four sheets of 1′ x 6′ (300 mm x 1800 mm) chipboard. The cuts don't come out quite as neatly as in the four-speaker column but c'est la vie! Once again you should be able to get one side and a top or bottom from one sheet of chipboard. The only difference in construction is that an extra cleat is put in across the middle of the box to provide extra bracing. To construct an eight-speaker column just follow the instructions given for the four-speaker column. All comments made about the four-speaker column apply equally to the eight-speaker column. ●

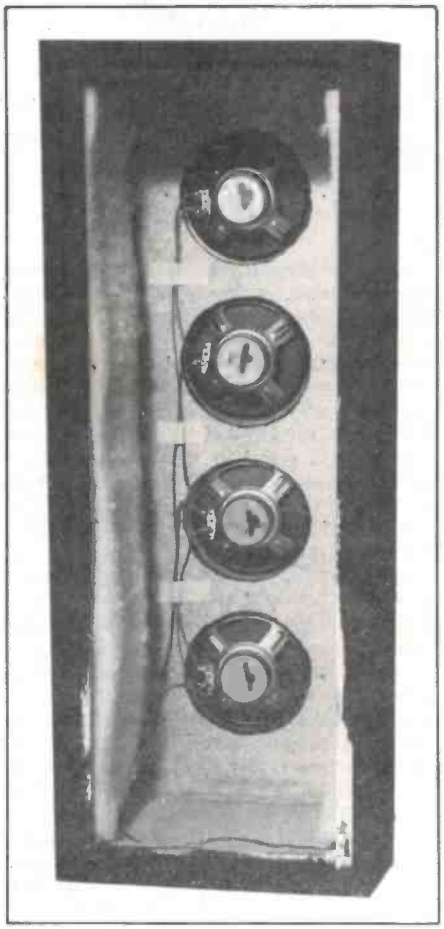
USING A LINE TRANSFORMER

If the need arises, as it often does in many larger halls, to drive a large number of speakers from the one amplifier, the job of trying to maintain the correct drive impedance to the amp and to ensure that all speakers share the power evenly can be quite a tedious one. To overcome these difficulties it is quite common in large systems to use line transformers to match impedances.

The way this works is that the output of the power amp is fed into a transformer which steps the maximum voltage up to a nominal 100 VRMS. Each speaker then has its own line transformer to step the voltage down to the level required by that particular speaker. Using a system such as this, speakers of different impedances and power ratings can be driven from the same amp without causing problems.

If it is desired to run the columns described in this article with a line transformer system, there is ample room on the floor of the box to mount the transformer. Take care, though, to mount it securely so it won't come loose even if the box is dropped. A paging amp system using a line transformer was described in the July 1984 issue of ETI.

Inside the small column. Showing wiring and placement of acoustic stuffing.



High quality 10-channel

RADIO MICROPHONE

Part 1

This is a tiny unit that plugs into the bottom of a microphone. The output can be received in a conventional FM tuner.

Ian Thomas

I'VE HAD quite a few requests now to have a look at a radio microphone with reasonably good performance. There've been circuits published already that have various degrees of quality from single transistor FM band units that must be about as stable as New Zealand, to ready-assembled units that work (more-or-less) OK. Others use a crystal oscillator which is great for stability but tough if someone else is using that particular channel. Getting the full 75 kHz deviation from a crystal-locked oscillator isn't easy and tends to be so tricky to align that it's almost impossible for the hobbyist to set up.

I did a lot of research before I started this project. I asked people what they wanted, and what the Department of Communications allowed. According to the word from those who guide us there are three bands available for radio microphones. A band at around 37 MHz can be used for AM or FM transmission but building reasonably efficient small antennas at this frequency is difficult (read: nigh on impossible). There's another band at 203 MHz used by radio and TV, but I didn't want to risk trouble interfering with Sale of the Century or some such essential service. There's a third band at around 910 MHz but working at these frequencies is *tricky* and very few people have the gear to set things up there. All three bands require that a receiver be built as well, which doubles the expense.

After a lot of soul searching I felt that the only way to give good performance at an affordable price was to use the 88-to-108 MHz FM broadcasting band. Most people already have a good receiver. I also reasoned that if the radio microphone was easily tunable to different channels then interference with broadcasting services would be minimised. The people using the microphone don't want to interfere with a broadcasting station for the simple reason that the broadcasting station will then interfere with them. All I had to do was ensure that it's always possible for the radio microphone to be adjusted to an empty channel. I'm sure this philosophy will induce howls of rage in certain circles but time will show it's a reasonable point of view.

The specs

To try to ensure that interference problems were really minimised I decided to adhere to all the other requirements laid down for commercial equipment: namely, frequency stability better than 0.002% if possible (that's the requirement for the 203 MHz FM band) and output stage power not to exceed 35 mW. As the radio microphone was to be used with ordinary FM receivers it must have 50 µs pre-emphasis as used in broadcast transmissions. To ensure good performance I decided to have at least better than 1%, or -40 dB, audio distortion. To make sure that the user could always find free space for transmission I also wanted at least half a dozen channels, switch selectable.

The only way the multi-channel requirement could be met was to use a frequency synthesiser of some sort. A range of ICs from Motorola will do the job. They use CMOS so don't draw much power, an essential requirement with battery powered equipment. The IC I chose was the Motorola MC145112 phase-locked loop synthesiser, but there are a whole range of devices with different options available — this one was ideal for the project.

As well as the frequency synthesiser chip a simple divider was needed that would divide down the actual output frequency to one that could be handled by the CMOS dividers in the synthesiser. Once again Motorola had the necessary with an ECL divide-by-64 prescaler that was absolutely ideal for the radio microphone. It only draws 4 mA — a considerable improvement on available devices.

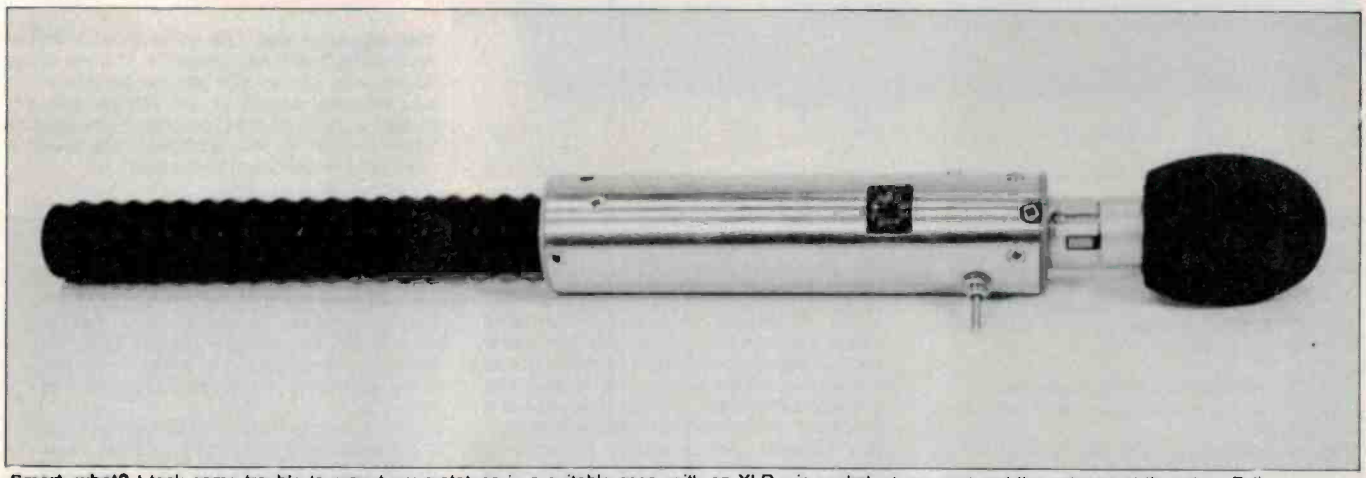
The audio part of the microphone gave no great problem as a careful choice of the dozens of op-amps available easily gave an input amplifier with a 70 dB signal to noise ratio. Because of space and power constraints I had to give away any ideas of limiting or AGC and rely simply on clipping to avoid gross overdeviation (crude, but effective!).

Design details

A great advantage of using a phase-locked loop (PLL) synthesiser as a signal source is that it's delightfully easy to frequency modulate. The heart of the synthesiser is the voltage controlled oscillator (VCO). This oscillator is running at the output frequency and is kept on frequency by the phase-locked loop. Any signal on the control voltage that sets the frequency will frequency modulate the output signal, so if the audio is deliberately added to the control voltage it gives exactly what we want, namely FM.

This is exactly what is done in the microphone where the dc control voltage is applied to one side of the varactor and the audio is applied to the other. If the control voltage was not filtered, then as the audio signal caused the output frequency to deviate the phase-locked loop would try to pull the output back to the nominal frequency. This would be a very frequency dependant effect and would result in the transmitter having no deviation at all at the low end and rather indeterminate response higher up. The loop low pass filter is added in the control voltage path to remove this problem and, as it starts to attenuate at about 0.5 Hz the modulation is flat to lower than 30 Hz — good enough!

The loop filter does two other essential jobs as well. As the phase-locked loop phase/frequency comparator operates at 3.9 kHz in this system it tends to have an output with ac components at 3.9 kHz and higher harmonics as well as the wanted dc



Smart, what? I took some trouble to mount my prototype in a suitable case, with an XLR mic socket at one end and the antenna at the other. Full mechanical description in Part 2. Other styles of housing are also acceptable — it's up to you.

signal. The discriminator is entirely digital so its voltage correction signals are very narrow spikes — super rich in harmonic! The loop filter must massively attenuate these spikes or when the modulator is running a 3.9 kHz whistle will be audible. In the final design the loop filter gives about 60 dB attenuation at the comparison frequency which is about enough.

The other function performed by the loop filter is to ensure that the phase-locked loop is stable and locks up without ringing. The design of control loops that are well behaved has long been a source of heartache and misery but given a few golden rules they usually work OK.

Designing the voltage controlled oscillator gave me by far the most trouble in the design. It is only an LC oscillator and must give the synthesiser all of its short term stability. The phase-locked loop can only hold the oscillator on frequency in the long term as short term corrections are deliberately filtered out to allow the oscillator to be frequency modulated. If the oscillator is noisy then this will show up as noise causing unwanted modulation when there's no input signal. The two basic rules for this are to use a low noise transistor and to use as high a Q tuned circuit as possible.

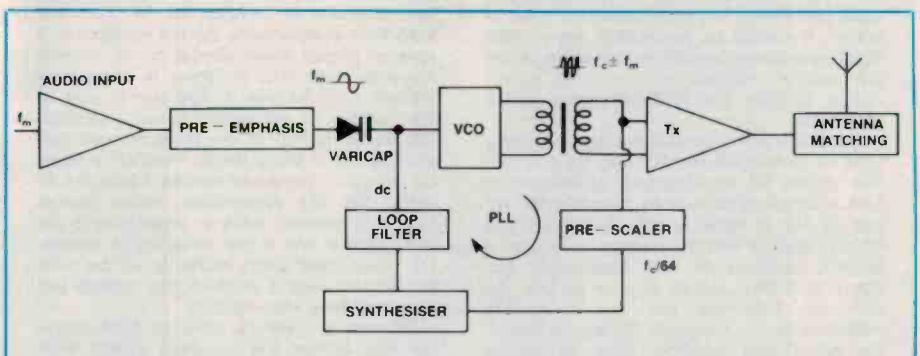
With regard to the first the 2N2857 has been around for a while and works fine. As for the second, almost all of the unloaded Q degradation is caused by the inductor and tuning diode. Neosid has recently made available a new assembly made specially for small FM receivers known as the K6 assembly. It's ideal for this job as it's very small and very cheap. The only problem is that the plastic they used for the coil former melts if you leave the soldering iron on the terminal pins for more than about three milliseconds — be warned!

To stop the transistor loading the tuned circuit too much and degrading its Q the tuned circuit should be of fairly low impedance. I chose about 80 nH for the inductor which gave about 30 pF for the total capacitance. 80 nH means that on the K6 assembly about three to four turns are needed which was nice and easy to wind. To get feedback for the oscillator you could either tap the main winding or wind on a separate winding like I did.

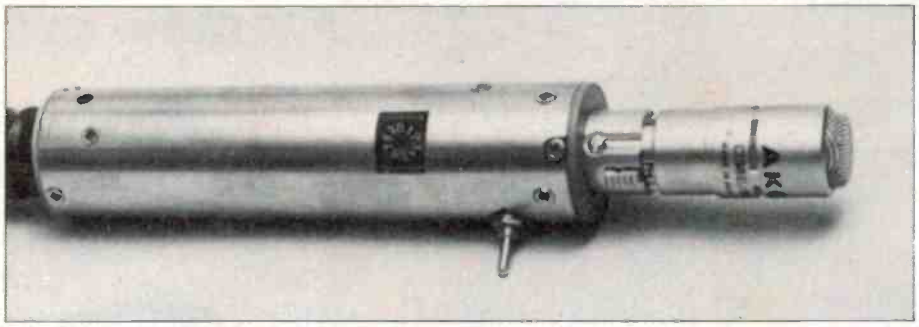
The oscillator

The oscillator is a common collector configuration where the tuned circuit is connected from the base to ground. The transistor only acts as an impedance converter with somewhat less than unity voltage gain. The resonant circuit is driven from a single turn low impedance winding driven by the emitter. One of the essential features of the oscillator is that it *must* isolate the frequency determining resonant circuit from the antenna and the rest of the transmitter. This is because it's inevitable that things will be moved near and around the antenna and the resultant impedance changes in the output load can pull oscillator frequency. The phase-locked loop will correct these errors but there may be audible bumps if the problem isn't prevented right from the outset. This is why the second transistor Q1 is in series with the oscillator transistor Q2. This configuration is called a cascode stage from the days of those funny glass things that lit up in the dark. The collector of the oscillator stage drives into the emitter of a common base stage.

A common base stage gives the best output to input isolation possible so Q1 buffers the oscillator from any reflected crud from the output stage. But coupling between the oscillator and the output presented its own set of problems. The input impedance to a common base stage is very low and the output impedance of the cascode common base stage is high. A broadband impedance transformer is needed to step the collector impedance down to match the input emitter impedance. A turns ratio of 5:1 or 6:1 is really needed as the input impedance of the output stage is about 10 ohms. This means a 6:1 transformer would transform the emitter impedance to about 360 ohms. The oscillator cascode output impedance is so high com- ▶



Block diagram. This shows the basic sections in the radio mic which employs a phase-locked loop synthesiser.



The 'business' end. This shows the unit with an AKG model D 58 E mic plugged in. This mic is only 42 mm long with an XLR plug on the end and is thus eminently suitable for use with the radio mic. It has a hyper-cardiod directional characteristic which is ideal for the application. The agent is AWA (who kindly loaned us the unit).

HOW IT WORKS — ETI-741

The radio microphone can be divided into nine sections that perform separate functions which are:

1) The audio input balanced amplifier
2) The audio pre-emphasis and band limiting filter
3) The voltage controlled oscillator
4) The synthesiser IC
5) The phase-locked loop filter
6) The transmitter output amplifier
7) The synthesiser prescaler
8) The output antenna matching network
9) The antenna

The audio input balanced amplifier is made up of IC1 together with resistors R1 to R5. The input is direct coupled to input resistors R1 and R2 as the input is assumed to be from a microphone whose two leads are floating with regard to earth. R3 and R4 form a potential divider which defines the dc operating point of the amplifier and the node between the two resistors is connected to the positive input of the amplifier. As the output stage of the CA3140 is not symmetrical the dc operating point is also not exactly between the rail and ground. The CA3140 output can only swing to about 1.5 V from the positive rail as it has a darlington pullup output transistor. However the pulldown transistor is a common emitter transistor so the output can swing to within about 0.2 V of ground. The dc bias on pin 3 reflects this asymmetry and if the amplifier is overdriven then the output is (more or less) clipped symmetrically.

The value of R2 and R3 in parallel is exactly equal to the value of R5 to within tolerancing limits. This ensures that if the two inputs are driven in common mode then the amplifier gives an attenuation of about 50 dB referred to the differential mode signal. However for differential mode signals the gain is equal to R5/R1 whether the non-inverting input (via R2) or the inverting input (via R1) or any combination of both is driven. It should be noted that not all FET input operational amplifiers will work at the low supply voltages of the radio microphone. Notably the TI TL081 gave severe distortion.

The audio pre-emphasis and band limiting filter is formed by R6, R7, R8, C2 and C3. The actual 50 microsecond pre-emphasis time constant is formed by resistors R6, R7 and C2 and is equal to (R6+R7)C2. C3 and R6 also ensure that the frequency response doesn't continue to rise indefinitely but starts to flatten out at around 20 kHz. As well as flattening out the frequency response at the high end R6 also prevents the operational amplifier from having to drive a capacitive load (C2 in series with C3) at high frequencies, something which would probably cause IC1 to oscillate.

The synthesiser integrated circuit is a CMOS device which provides all the necessary components to form a complete phase locked loop synthesiser whose operation is described elsewhere. All that is needed is a reference crystal with its associated capacitors between pins 3 and 4, a switch to select frequencies connected to pins 14 to 17 and a loop filter to the output pin 6. The synthesiser programmable divider control inputs are hard wired to give the desired band of frequencies out via pins 9 to 13 and by selectively cutting tracks to these pins any band of frequencies in the 88 to 108 MHz band may be selected. An "out of lock" signal is also available from the IC via pin 7 but was not used in this design. It indicates whether the discriminator is operating in the 'phase' or 'frequency' mode and is a useful indication as to whether the synthesiser output is useable or not.

The voltage controlled oscillator is a cascade transistor oscillator using a hyper-abrupt junction varactor (D1) as its tuning element. The actual oscillator is a common collector amplifier (Q1 and Q2) with the LC resonant circuit connected to the base. Positive feedback is taken from the emitter through a single turn close coupled to the inductor of the resonant circuit. DC bias to the base of the transistor is provided from the reference voltage generator IC4 through R13 and is connected to the 'earthy' end of the resonator inductor. C14 bypasses this reference voltage and ensures that the cold end of the inductor is at ac earth.

Capacitor C12 isolates the varactor (D1) from the dc potential at the base of the transistor and also pads out the varactor capacitance and reduces its frequency pulling range. C13 in parallel with the inductor further pads out the varactor capacitance and sets the centre frequency of the oscillator. Varactor bias from the synthesiser IC is provided from R12 which also ensures that the resonator is isolated for RF from the loop filter components. As the varactor is a reverse biased diode almost no dc current flows through R12 so there is almost no voltage drop across it. The anode end of the varactor is connected to earth through R8. As R8 is part of the pre-emphasis network which is being driven from IC1 a small dc voltage is produced across it (about 0.25 volts) but the synthesiser phase locked loop automatically adds an equal bias to the cathode end and it has no effect. A capacitor could have been added in series with the op-amp output to block this voltage but it was deemed unnecessary.

Q1 acts as a simple common base amplifier and buffers the oscillator circuit from any reflected power from the antenna. It provides no effective gain and from a power point of view the collector of Q2 could have been connected directly to the interstage transformer L4. However as the oscillator *must* be very stable to avoid unwanted noise sidebands the second transistor was added in.

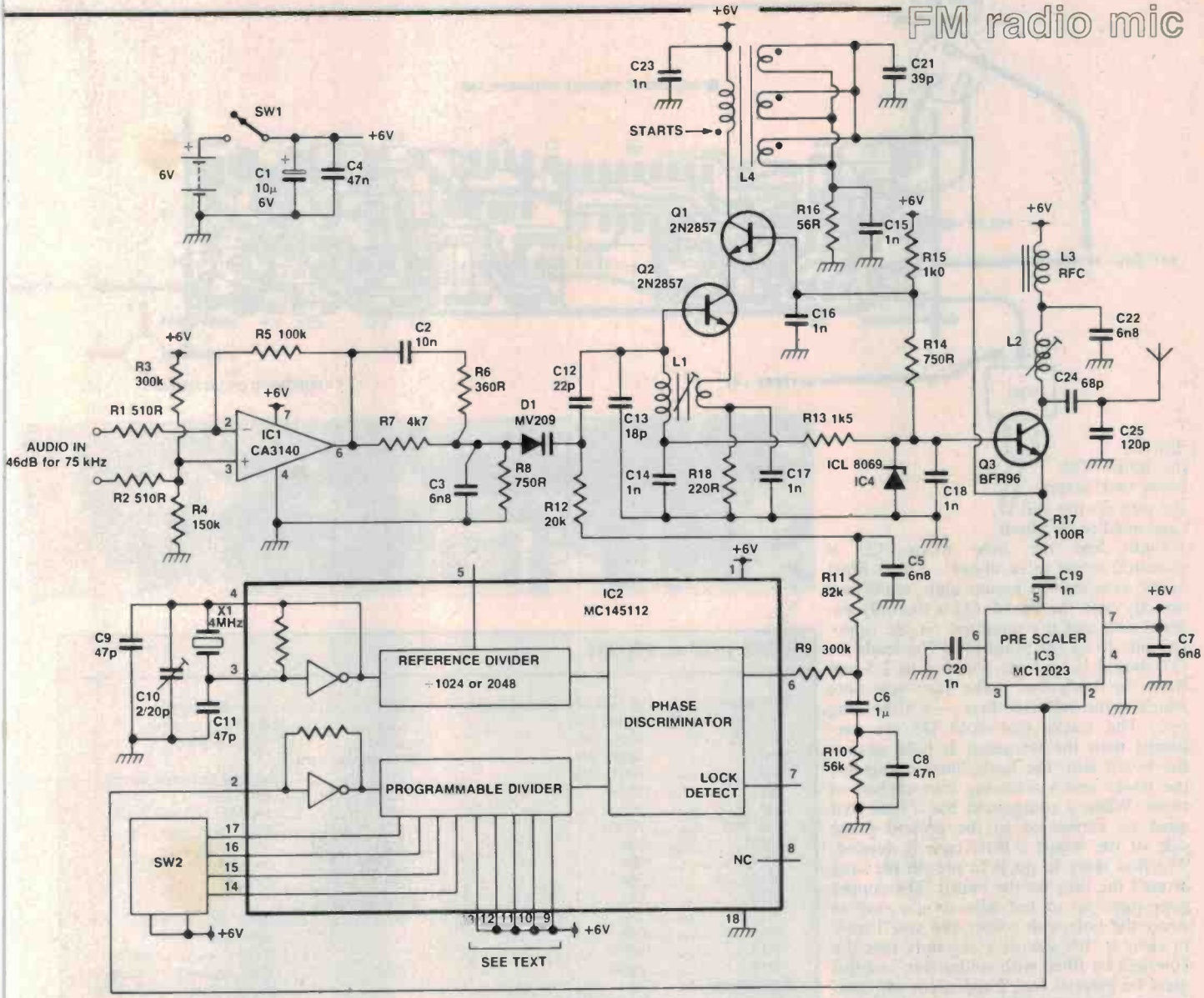
The interstage matching transformer L4 is a 6:1 broadband step-down toroidal transformer that transforms the 9.5 — j7.3 ohms input impedance of Q3 to about 350 ohms. C21 resonates out some of the leakage inductance of the transformer and improves coupling. The winding of the transformer is described elsewhere and ensures that the two windings are tightly coupled.

The output stage is also a common base stage once again to improve isolation of the antenna from the oscillator section. The base is biased directly from IC4 with ac decoupling from C18. Emitter current in the output stage is set by R16 which is bypassed by C15. The secondary of the transformer L4 is in series between R16 and the emitter of Q3. The collector of Q3 is matched to the antenna by L2 and capacitors C24 and C25. The matching is done into a 50 ohm load and as the helical antenna looks like 50 ohms at its resonant frequency excellent power transfer is achieved.

At frequencies below antenna resonance the helical antenna becomes capacitive and its matching network becomes inductive so the combination of the two provides a good match over the entire 10 channel band. The combination of the antenna and its matching network can be thought of as a band pass filter with a bandwidth of about 4 MHz. If it is desired to use the transmitter into a quarter wave length of wire then the matching network will work equally well as the helical antenna looks electrically very similar.

The output power supply is solidly bypassed by a radio frequency choke, L3 together with a capacitor C22. The output stage produces quite high RF currents which must be kept from the rest of the circuitry if oscillator pulling is to be avoided.

A signal is taken from the emitter of the output stage to drive the synthesiser prescaler through R17 and C19. The prescaler is an ECL high speed fixed divider that can accept up to 225 MHz input signals and give out a signal that has been divided down in frequency by 64. The output of the divider is at TTL levels and can be directly coupled to the synthesiser IC2. All the prescaler requires is an ac coupled input signal, a bypass capacitor for an internal reference level and good supply bypassing. It has been specifically designed for low power operation so is ideal for this application.



pared to this sort of impedance that it can be considered to be a constant current generator so the power coupled into the emitter of the output stage can be described by

$$P = n^2 i_{osc}{}^2 R_e$$

where n is the broadband matching transformer turns radio, R_e is the output stage emitter input impedance, and i_{osc} is the oscillator output ac current available.

The output transistor is a BFR96 which is capable of about 18 to 20 dB of power gain at these frequencies. The transistor is designed for broadband amplifier operation for CATV and MATV and has an f_T of about 5 GHz with the right collector current so for our case it is almost operating at dc and very high gains can be achieved. Hence if 30 mW of transmitter output power is wanted we only need about 0.3 to 0.4 mW of input power. Shoving all these figures into the recipe given above we get that with a 6:1 turns ratio we need an oscillator output ac current of about 1 mA. By fiddling with the value of R18 we can set this as required.

For a guide to components and kits for projects, see SHOPAROUND this issue.

The antenna

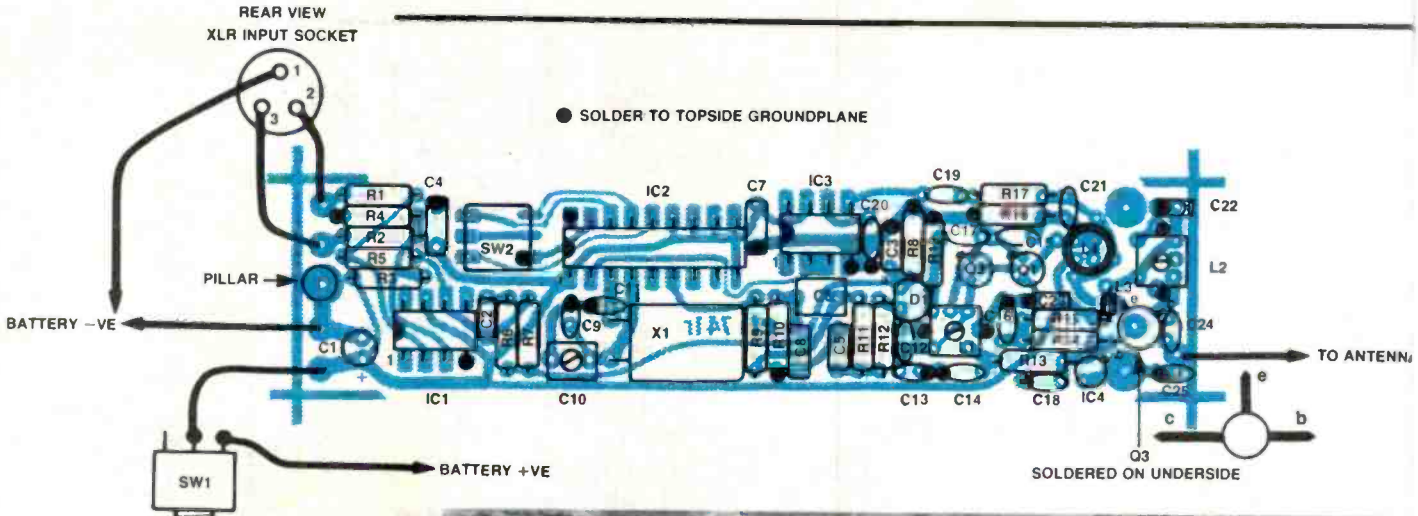
I gave a lot of thought to what was wanted in the antenna. If a piece of wire is wound into a helix then it can start to take on the properties of both an inductor *and* an antenna, so eliminating the need for a large inductor in this case. If the diameter of the helix is much smaller than the wavelength then the antenna produced is called a 'normal mode helical' antenna (there's another good word to hit your friends with) and can be designed to look electrically rather like a simple whip but with a somewhat lower radiation resistance. This is the principle behind the so-called 'rubber duckie' antennas. It's as if the tuning inductance at the base of a short whip antenna is distributed along the antenna. This principle can be carried a great deal further than is normally done with the 'rubber duckies'. Design recipes are available to ensure that the final antenna is purely resistive.

Construction

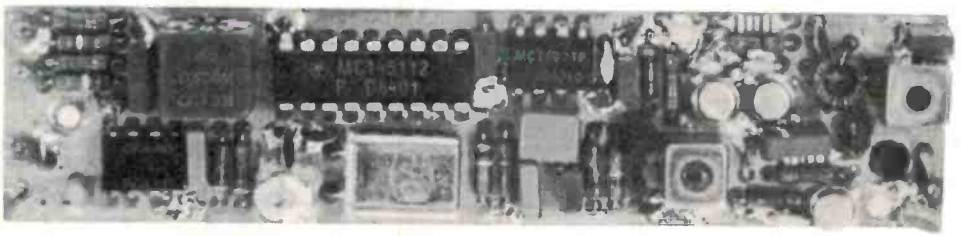
The first part of the transmitter to be made is the printed circuit board. As some quite high currents can flow in parts of the circuit at 100 MHz a good solid ground is needed so double-sided board is used with all of one side being groundplane. I taped up the wiring side with one-to-one tape then made a second artwork by using pads to cover the places where I wanted component leads to come through the board and not contact the groundplane. The groundplane artwork was then reversed using 'Scotchcal' reversing film. If you don't want to make your own artwork you can buy it from ETI (see Shoparound). Given the right artwork making double-sided boards is not much more complicated than making single-sided.

All you have to do is exactly line up the two artworks over each other and tape them together on two opposite sides.

After etching, strip off the resist and ▶



drill all the holes. The holes that accept the pins on the coil cans need to be about 1.3 mm and the hole where Q3 is mounted needs to be about 5 mm. Most of the components mount quite easily and directly onto the board. Q3 is the only unusual one and it's mounted on the opposite side to all the other bits. The leads for Q3 should be cut off about 2 to 2.5 mm from the body but make sure you note which is the collector first — it's the long one. The tracks that hold Q3 are pre-tinned then the transistor is held against the board with the leads lined up against the tracks and a soldering iron applied to them. When a component has a lead that must be connected to the ground plane side of the board a little care is needed. The first thing to do is to pre-tin the area around the hole on the board. The copper goes right up to the hole so it's easy to cover the hole with solder and you'll have to clear it. It's almost a certainty that the hole will be filled with solder flux and this must be cleared too. I use a cut off component lead held about 5 mm from the end *firmly* with pliers and jam it through the hole. Then pre-tin the component (resistor or capacitor) lead right up to the body. This bends the rules of component soldering a bit but if you use a temperature controlled soldering iron and be quick it should be OK. Finally place the component in the holes and solder the earth lead to the ground plane with the component body 2 or 3 mm from the board. Keep the solder molten by keeping the soldering iron tip on the ground plane next to the lead and make sure the solder meniscus isn't broken. Slide down the component until it's about 0.5 mm from the board and let things cool off. Then solder both leads on the wiring side and it's done. This procedure's a bit messy but it's important to get a good earth, particularly for the bypass capacitors. For Q1 and Q2 just solder the leads on the wiring side. For the IC leads that go to earth it's quite easy to just form a fillet of solder on the outside of the lead to ground and it'd be *most* unwise to cook the bejesus out of a $10 synthesiser IC.



PARTS LIST — ETI-741

Resistors ..... all ¼W, 2% unless noted
- R1, R2 ..... 510R, ½%
- R3, R9 ..... 300k, ½%
- R4 ..... 150k, ½%
- R5 ..... 100k, ½%
- R6 ..... 360R
- R7 ..... 4k7
- R8, R14 ..... 750R
- R10 ..... 56k
- R11 ..... 82k
- R12 ..... 20k
- R13 ..... 1k5
- R15 ..... 1k0
- R16 ..... 56R
- R17 ..... 100R
- R18 ..... 220R

Capacitors
- C1 ..... 10µ/6 V tant.
- C2 ..... 10n/63 V met. poly.
- C3, C5, C7, C22 .... 6n8 ceramic monolithic
- C4 ..... 47n ceramic monolithic
- C6 ..... 1µ/63 V met. poly.
- C8 ..... 47n/63 V met. poly.
- C9, C11 ..... 47p NPO ceramic
- C10 ..... 2-10p Philips trimmer type 2222-809-05002
- C12 ..... 22p NPO ceramic
- C13 ..... 18p NPO ceramic
- C14, 15, 16, 17, 18, 19, 20, 23 ..... 1n Hi-K ceramic
- C21 ..... 39p NPO ceramic
- C24 ..... 68p NPO ceramic
- C25 ..... 120p ceramic

Semiconductors
- D1 ..... MV209 Motorola varicap
- IC1 ..... CA3140E
- IC2 ..... MC145112P Motorola
- IC3 ..... MC12023P Motorola
- IC4 ..... ICL8069 Intersil
- Q1, Q2 ..... 2N2857
- Q3 ..... BFR96

Miscellaneous
- SW1 ..... SPST toggle switch, C & K 'tiny toggle', type T1001-SHZQ, or similar
- SW2 ..... E10-position BCD-coded switch, Eeco type 231002, right-angled pc mount.
- X1 ..... 4.000 MHz crystal, parallel resonant with 30p load.

ETI-741 pc board (double-sided); two Neosid K6 coil assemblies; Philips toroid, 6 mm O.D. by 4 mm I.D. by 2.5 mm thick, 4C6 ferrite (or similar); 3 mm by 3 mm ferrite bead; one XLR line socket; wire for winding coils and antenna (see text); hookup wire; mechanical components (see text — or as required).

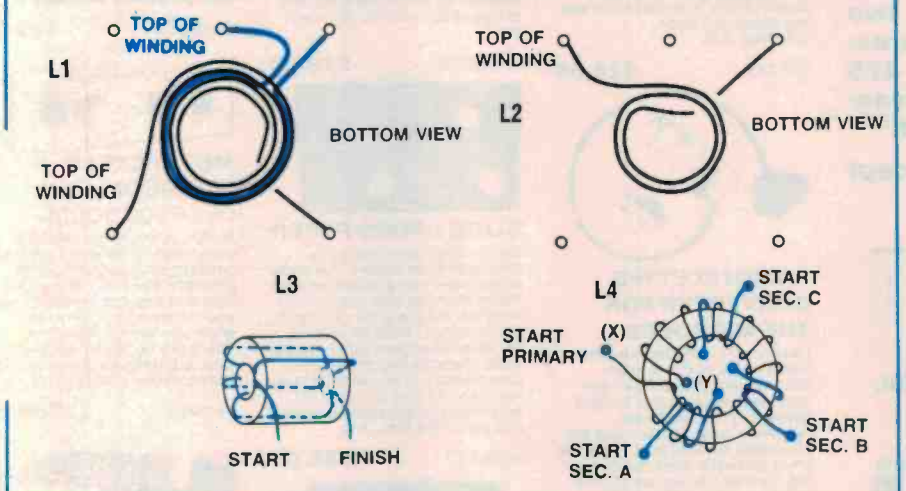
Price estimate: $35-$42
(not including microphone)

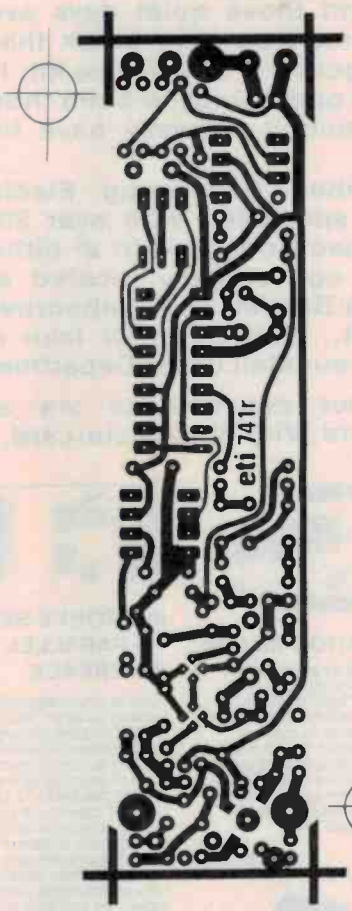
Winding coils

Winding the coils and transformers is the next job. The easiest is the radio frequency choke, L3, so we'll start with that. It consists of 4½ turns of wire wound on a ferrite bead 3 mm long by 3 mm in diameter and wind the turns spaced 60° diameter and wind the turns spaced 90° apart on the bead. Tin the ends of the wire to within about 1 mm from the bead and solder it onto the board.

The next one is the broadband transformer, L4. Using the same wire as for the choke wind 12 turns evenly and tightly around the toroidal core. I used a Philips grade 4C6 ferrite core 6 mm in diameter but Neosid makes an equivalent RF ferrite. Either should work OK though I didn't try the Neosid one. The turns should be evenly spaced and go all the way around the core so the two ends of the winding are within 1 mm or so of each other. Next wind the three secondary windings using a heavier wire, say 0.25 mm. Each winding has two turns

Figure 1. Coil winding details. The winding and termination of L4 should be viewed with respect to the pc board overlay at left.





wound between the primary turns and each winding is spaced 90° from the next around the core. The board layout is done assuming the secondary turns are done in a certain sense so before you wind them look carefully at the board and make sure that the ends of the secondary windings come off the core in the right place to go neatly through the holes in the board with no bending.

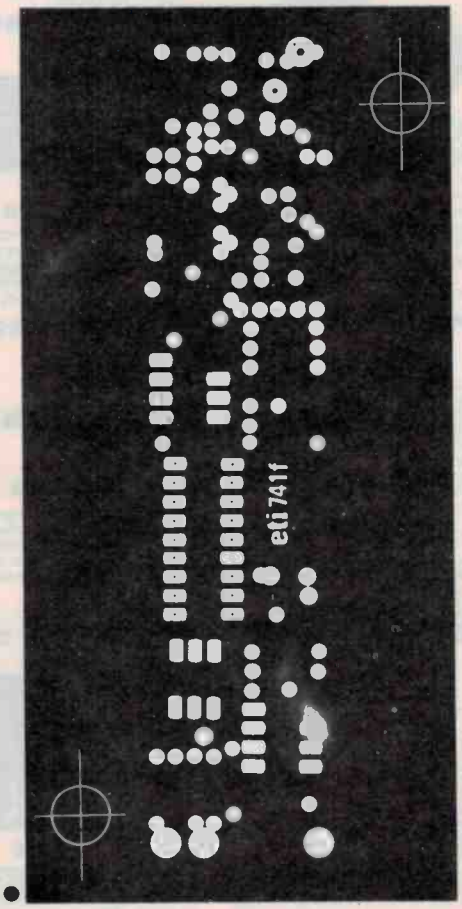
Tin all the leads to within 1 mm of the core and carefully sort out the leads and thread them through the appropriate holes. It's essential that no secondary winding be reversed in sense from any other. Lower the toroid down onto the board until it's about 1 mm from the board and check that all the secondaries come straight off the core and through the board. The secondary windings should securely hold the transformer in place so when the leads are soldered no further mounting is needed. The phasing of the primary winding isn't important but make sure the two primary leads don't cross over each other.

The output matching coil L2 uses a Neosid K6 assembly but only has one winding so it is pretty easy to wind. The winding should be a nice stout wire, say 0.3 to 0.35 mm diameter. Cut a piece of wire about 50 mm long and tin 3 mm of one end. Form the tinned end into a tiny hook and hook it around the pin of the coil former indicated in Figure 1. Push the hook right up against the body of the coil former and crimp it tight with a pair of fine long- nosed pliers. Solder it in place *quickly* using the bare minimum amount of solder possible. The coil former's made of a plastic that isn't at all resistant to heat and if you take more than about a second the pin will come loose.

Loop the wire around and onto the coil former body. Wind two and a quarter turns spacing the turns a distance approximately equal to the diameter of the wire. Before bending the wire down to go over the other pin, tin it to within about 4 to 5 mm from the coil former. Then bend it down and wrap it around the terminal pin. Crimp it with long nosed pliers and solder it as before. Try the ferrite cup core on to make sure it'll fit right over the winding.

Finally paint the winding with polystyrene lacquer to hold the winding in place. If you can't get this sort of lacquer some clear nail varnish would do. Then glue the outer cup core in place using superglue making sure that it goes completely over the winding and almost down to the base of the former. The coil can then be soldered in place. The coil can should then be slipped over the coil and its two pins soldered down. It's not necessary to solder it on the earth side of the board — you'd risk damaging the former. Just solder the wiring side.

The last and most awkward coil is the oscillator coil L1. The primary has 3.75 turns of 0.25 mm diameter wire. Start by tinning one end as for L3 and attach it to the pin shown in the winding detail Figure 2 once again using the absolute minimum amount of solder. Wind on the 3.75 turns spacing them slightly more than a wire diameter apart. Tin the loose end as for L3 but allow a bit more insulation to stay, say 6 mm, and terminate the end on the pin shown. Next, using some 0.35 mm wire thread the secondary once under the primary lead half way up the coil and wrap it once tightly around the coil former. Squeeze the two ends together so they come away from the coil former and tin them to within 5 mm from the former. Bend them down to the space in the former for the wires to go through to the terminating pins and terminate them as shown on the diagram . . . **to be continued.** ●



PERFECT PROJECTS FOR THE CHRISTMAS BREAK! What better way to spend those quiet days over the Christmas/New Year break than putting together an electronic kit. It's the perfect opportunity to build those kits you wouldn't normally have time to do.

Remember, Rod Irving Electronics are kit specialists with over 250 kits to choose from. Call in at either two of our conveniently located stores: 48-50 A'Beckett St., Melbourne,, 425 High St., Northcote. Or take advantage of our Mail Order Department.

For your convenience we accept Bankcard, Visa and Mastercard.

CAR IGNITION KILLER

Most car burglar alarms are easily circumvented, but not this cunning "Ignition Killer". This sneaky antitheft device uses a 555 timer to place an intermittent short circuit across the points. Until disabled by its hidden switch the circuit effectively makes the car undriveable — a sure deterent to thieves! (EA Feb. '84).

84AU1 **$16.95**
(Our kit includes the box!)

ELECTRONIC MOUSETRAP

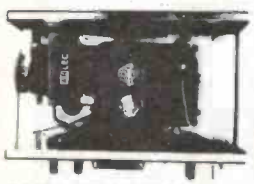
This clever electronic mousetrap disposes of mice instantly and mercifully, without fail, and resets itself automatically. They'll never get away with the cheese again! (ETI Aug. '84).

Cat. ETI 1524 **$29.95**

TEMP PROBE

Can measure temperature from −50° to +150°C. It simply plugs into your multimeter — great for digital multimeters. Accuracy of 0.1°C resolution of 0.1°C. (ETI June '83).

ETI-153 **$22.50**



DUAL TRACKING POWER SUPPLY

Built around positive and negative 3-Terminal Regulators, this versatile dual tracking Power Supply can provide voltages from ±1.3V to ±22V at currents up to 2A. In addition, the Supply features a fixed +5V 0.9A output and is completely protected against short circuits, overloads and thermal runaway. (EA March '82)

82PS2 **$87.50**

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 **$55.00**

PHONE MINDER

Dubbed the Phone Minder, this handy gadget functions as both a bell extender and paging unit, or it can perform either function separately. (EA Feb. '84).

84TP2 **$24.00**

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 **$9.50**

MODEL ENGINE IGNITION SYSTEM

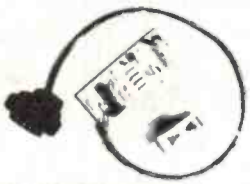
Get sure starts every time and no more glow plug burnouts on your model engines. (ETI June '83)

ETI-1516 **$41.50**

PUSHBUTTON-PROGRAMMABLE WIPER CONTROLLER

No more fiddling with knobs and not getting the delay between wipes that you want — this windscreen wiper controller is simply programmed with two pushbuttons to provide the wiping delay you need. (ETI Mar. '83).

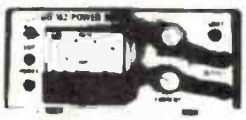
ETI-335 **$28.50**



RADIOTELETYPE CONVERTER FOR THE MICROBEE

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

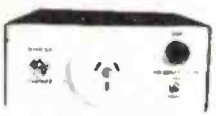
ET733 **$20.00**



30 V/1 A FULLY PROTECTED POWER SUPPLY

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

ETI-162 **$49.50**



INVERTER

This 12 240V inverter can be used to power 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 **$49.50**

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 of perhaps even more sinister noises. The current cost of components for this project is around $15 including sales tax, but not the cost of batteries or headphones. (EA Nov. '83)

83MA11 **$15.00**

FUNCTION GENERATOR

This Function Generator with digital readout produces Sine, Triangle and Square waves over a frequency range from below 20Hz to above 160Hz with low distortion and good envelope stability. It has an inbuilt four-digit frequency counter for ease and accuracy of frequency setting. (EA April '82)

82AO3A/B **$79.50**

SLIDE CROSS-FADER

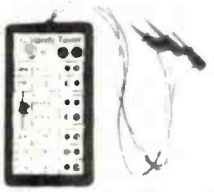
Want to put on a really professional slide show? This slide cross-fader can provide smooth dissolves from one projector to another, initiate slide changing automatically from an in-built variable timer, and synchronise slide changes to pre-recorded commentary or music on a tape recorder. All this at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

81SS11 **$85.00**

TV PATTERN GENERATOR

Anyone wishing to obtain the maximum performance from a colour TV receiver needs a pattern generator. Why not build this completely new design which provides five separate patterns, dot, crosshatch, checker-board, grey scale and white raster. (EA June '80)

80PG6 **$67.50**

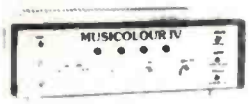


TRANSISTOR TESTER

1000's SOLD

Have you ever desoldered a suspect transistor, only to find that it checks OK? Troubleshooting 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 **$15.00**



MUSICOLOR IV

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 **$84.00**

ELECTRIC FENCE

Mains or battery powered, this electric fence controller is both inexpensive and versatile. Based on an automotive ignition coil, it should prove an adequate deterrent to all manner of livestock. Additionally, its operation comforms to the relevant clauses of Australian Standard 3129. (EA Sept. '82)

82EF9 **$19.50**

MOTORCYCLE 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).

84CM5 **$36.50**

12-230V DC-AC INVERTER

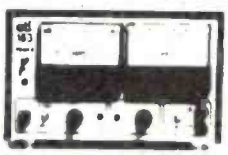
INCLUDING TRANSFORMER 300 WATTS

This EA Inverter is capable of driving mains appliances rated up to 300VA and features voltage regulation and full over load protection. (EA June '82).

Nominal Supply Voltage	12V DC
Output Voltage	see table
Frequency	50Hz± .005%
Regulation	see table
Maximum Load	300VA
Current Limiting	30A (primary)
Efficiency	see table

P & P $10.00. Anywhere in Australia.

82IV6 **$195.00**



LAB SUPPLY

Fully variable 0-40V current limited 0-5A supply with both voltage and current metering (two ranges: 0-0.5A/0-5A). This employs a conventional series-pass regulator, not a switchmode type with its attendant problems, but dissipation is reduced by a unique relay switching system switching between taps on the transformer secondary. (ETI May '83).

ETI-163 **$175.00**

50V 5A LABORATORY POWER SUPPLY

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

83PS5 **$140.00**

Errors and Ommissions Excepted

CENTRE RETURN JOYSTICK

Features 2 x 150K pots, long shaft 40mm with 25mm control ball. Bonus adjustable offset feature on pots.

Cat. X15637 1-9 10+
$9.95 $8.95

ECONOMY TOGGLE SWITCHES

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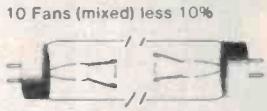

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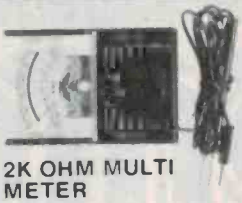

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11 Ranges, pocket size.

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OHMETER: 0-10 k/ohms, 0-1 mega-ohms.
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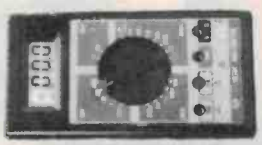

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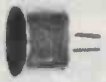

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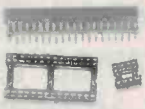

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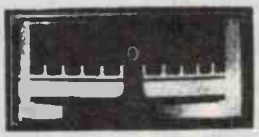

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065 Electronic siren	$5.90
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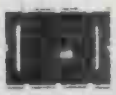

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YFE YF1100 FEATURES

- ★ Large, easy to read 3½ digit display.
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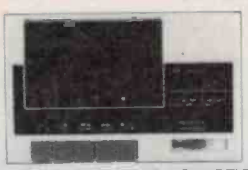

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9668PC	High Current Voltage, Darlington Driver	.87

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UA317UC	3-Terminal Positive Adjustable	.65
UA431AWC	Adjustable Precision Shunt	.48
UA494DC	Pulse Width Modulated Control Circuit	$1.88
UA494PC	Pulse Width Modulated Control Circuit	$1.30
UA78L62AWC	3-Terminal Positive	.30
UA78L82AWC	3-Terminal Positive	.30
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- Anti-glare screen.
- Suitable for professional or home use.

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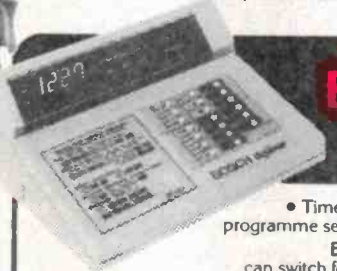
SPECIFICATIONS

Picture Tube	: 12", 90° Deflection	Input Signal Connector	: RCA (female) Pin Jack
Display Format	: 80 character x 24 rows. 9 dots, 10 line/character	Hor. Sync. Frequency	: 15.75±0.3 kHz (Standard 15.75 kHz)
Display Area Example	: (H) 210mm (8²⁹/₃₂ inches) (V) 150mm (5²⁹/₃₂ inches)	Ver. Sync. Frequency	: 49 – 61Hz (Standard 60Hz)
Input Signal	: Composite Video/Sync. 1.0 Vp-p (Negative Sync.)	Video Band Width	: 22 MHz
Input Impedance	: 75 ohm	Resolution	: 720 pixels x 240 lines
		Linearity	: Horizontal 8%, Vertical 8%
		Geometric Distortion	: ±2%



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7812	12 1.5 AMP	.95
7815	15 VOLT 1.5 AMP	.95
7824	24 VOLT 1.5 AMP	.95
78L05	5 VOLT 100ma	.46
78L12	12 VOLT 100ma	.46
78L15	15 VOLT 100ma	.46
78L24	24 VOLT 100ma	.46
NEGATIVE		
7905	5 VOLT 1.5 AMP	.95
7906	6 VOLT 1.5 AMP	.95
7908	8 VOLT 1.5 AMP	.95
7912	12 VOLT 1.5 AMP	.95
7915	15 VOLT 1.5 AMP	.95
7918	18 VOLT 1.5 AMP	.95
7924	24 VOLT 1.5 AMP	.95
79L06	6 VOLT 100ma	.46

		PRICE
79L15	15 VOLT 100ma	.46
79L18	18 VOLT 100ma	.46
79L24	24 VOLT 100ma	.46
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LM323K	5 VOLT 3 AMP	$5.09
78H05SC	5 VOLT 5 AMP	$10.07
7812KC	12 VOLT 1.5 AMP	$1.31
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ADJUSTABLE		
LM337K	NEG. 1.2 TO 37 VOLT	$5.64
LM337T	NEG. 1.2 TO 37 VOLT	$1.38
LM317T	POS. 1.2 TO 37 VOLT	$1.73
LM338K	POS. 1.2 TO 32 VOLT	$8.76
LM396K	POS. 1.2 TO 15 VOLT	$21.09
SH1605	SWITCHING 3 TO 30 VOLT	$14.01
78GUC	POS. 1 AMP 4 TERM. ADJ.	$1.86
79GUC	NEG. 1 AMP 4 TERM. ADJ.	$1.86

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74HC02N	QUAD 2 I/P NOR	.85
74HC03N	QUAD 2 I/P NAND	.85
74HC09N	QUAD 2 I/P AND	.85
74HC10N	TRIPLE 3 I/P NAND	.85
74HC11N	TRIPLE 3 I/P AND	.85
74HC20N	DUAL 4 I/P NAND	.85
74HC21N	DUAL 4 I/P AND	.85
74HC27N	TRIPLE 3 I/P NOR	.85
74HC30N	8 I/P NAND	.85
74HC36N	QUAD 2 I/P NOR	.85
74HC42N	1 OF 10 DECODER	$1.58
74HC51N	AND/OR INVERTER	.85
74HC74N	DUAL J/K FLIP FLOP	$1.20
74HC76N	DUAL J/K FLIP FLOP	$1.20
74HC86N	QUAD EX-OR GATE	$1.10
74HC107N	DUAL J/K MASTER F/F	$1.10
74HC112N	DUAL J/K FLIP FLOP	$1.20
74HC113N	DUAL J/K FLIP FLOP	$1.20
74HC139N	DUAL 2/4 LINE DEC-MUX	$1.54
74HC151N	DATA SELECTOR MUX	$1.41
74HC160N	SYNC. 4 BIT COUNTER	$2.05
74HC165N	8 BIT SHIFT REGISTER	$3.08
74HC175N	QUAD D FLIP/FLOP	$1.58
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74HC244N	OCTAL LINE DRIVER	$3.23
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74HC253N	DUAL 4/1 LINE DATA SEL/MUX	$1.44

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74HC266N	QUAD 2 I/P EX-OR	$1.10
74HC368N	HEX BUS DRIVER	$1.85
74HC378N	HEX D FLIP/FLOP	$3.08
74HC390N	4 BIT COUNTER	$2.20
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75HC623N	OCTAL BUS TRANSCEIVER TRUE.	$5.59
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75HC643N	OCTAL BUS TRANSCEIVER T/I	$5.59
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2516-(2716)	16K (2Kx8) EPROM T.I.	$4.27
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27128	128K (8Kx16) EPROM (FLW.)	$34.50
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4416	16Kx4 DYNAMIC RAM	$17.94
6116-3(8416)	2K x 8 CMOS	$8.04
8114	1025x4 STATIC RAM	$4.60
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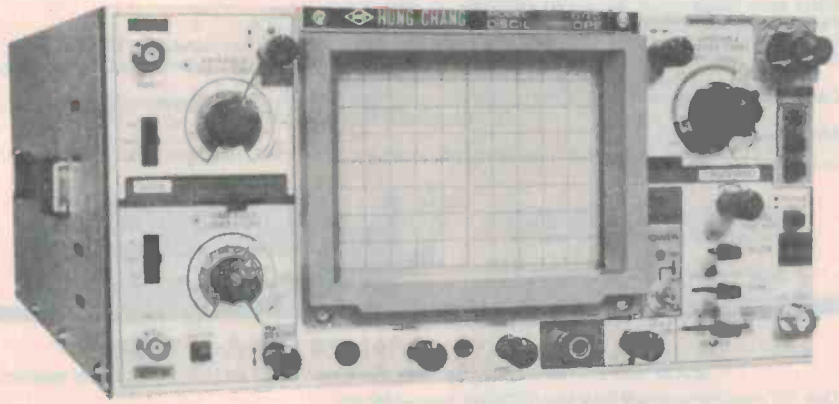


ACCORDING TO THE MANUAL the Hung Chung OS-645 was developed in reply to requirements for an oscilloscope that could be used to troubleshoot high speed electronic equipment. It has a claimed bandwidth of 45 MHz and an extra bright screen to allow the display of very fast waveforms.

The first thing one notices about the '645 is that it is a nicely laid out unit, with all the controls exactly where one would expect them. This is a big plus if only because it means it's not necessary to read the manual in order to display a waveform and use it to troubleshoot. In fact the front panel is virtually identical to the very popular Aaron oscilloscope.

Of course if you do read the manual the theory is that you should then be in a position to operate the equipment to the full extent of its capability. With the Hung Chung however that is not quite the case. It proved to be easier to experiment with the unit itself than to try to decipher the Honda English in the manual. This is particularly true of the Delay function, which proved almost impossible to understand, but thankfully, operates in a reasonably straightforward fashion.

Not that the manual is totally useless. It has block diagrams showing the system operation, and diagrams showing the position and function of all the set-up pots. There is a complete circuit diagram as well as a comprehensive parts list. There is even a lengthy section on the operation of the CRO. Unfortunately, there is an inverse relationship between the number of words on the page and its comprehensibility. Such is life.

The two channels on the OS-645 can be operated individually, or in chop, dual or add mode, as one would expect. The chop frequency is about 200 kHz. Vertical deflection can be switched in ten steps between one volt per cm and 0.001 volt per cm. This range can be extended by a x5 switch, so allowing five volts to 5 mV.

I would have wished for more on the top end of this scale. Most CROs can manage at least 10 V per cm. This gives the ability to display 80 V directly on the screen and 600 V with the aid of a x10 probe. In general workshop operation this seems to give the required degree of flexibility. As it is, one is limited to 40 V on the screen. There is also an absolute limit of 600 V on the input of the OS-645.

This need not be an overwhelming objection however, if one is primarily engaged in troubleshooting boards at standard logic levels where the most you will ever need is the ability to display five volts. Rarely perhaps, you may need to look at a transformer primary, and you can do that easily enough with a x10 probe.

I didn't have any equipment that could reliably test the manufacturers claims for high speed performance, so I had to content myself with some impressionistic figures gained by feeding the '645 a sine wave from the HP 8645B signal generator in our lab. Since this has a claimed frequency range of 10 MHz to 520 MHz I would assume any attenuation effects are due to limiting of the CRO and not the generator.

On this basis the CRO started to roll off at 17 MHz. I measured the 3 dB point at 31 MHz. At 45 MHz the signal is 5.2 dB down. In an effort to improve these figures I played around a bit with the most obvious source of high frequency attenuation, namely the leads. The best CRO leads I could lay my hands on were the TEK P6106 pair we have in the lab. Capacitance is rated at 13 pF. Nothing I did would bring the 3 dB point up, so I would hazzard a guess that the manufacturer is being just a wee bit optimistic in his claims.

To compensate though, the manual underrates the high frequency performance of the trigger circuit. This is claimed to be 80 MHz, but I was able to measure a waveform running at 92 MHz. The trigger circuit is also respectably responsive to very short pulses. I set up our Wavetek to output a 1kHz squarewave and then proceeded to shorten the pulse length until I lost triggering. As it happened the CRO outperformed the Wavetek. There was always some setting on which it was possible to find the pulse, even when I shortened it as much as possible, i.e: to 10 nS. At this speed you need the brightness turned right up and the x5 expansion out, but you can still see the pulse tip.

The brightness of the trace was another thing that pleased me. Hung Chang have gone to a 15 kV accelerating voltage for the screen and it shows in a nice bright screen, even at high frequencies. In fact the only time I ran into brightness problems was the incident mentioned above, when I was trying to see an extremely small pulse with the timebase fully extended. Certainly there are no problems using the full deflection of the screen at the highest bandwidth.

It is possible to externally modulate the brightness of the CRO through the Z input on the back panel. (Why it has become traditional to put the Z input on the back panel is beyond me. Are CROs designed by gorillas?) The Z input is set at TTL levels with positive voltage leading to a brighter display, and visa versa. The bandwidth is set at 1 MHz.

In short the OS-645 strikes me as good value for money, especially if you need the ability to display waveforms up to 20 MHz. It retails from **Rod Irving Electronics at 425 High Street, Northcote Vic 3070** for $1045 including tax. ●

SPECIFICATIONS AT A GLANCE

150 mm CRT screen
15 KV accelerating voltage.
CH-A, CH-B, Dual, Add, Chop and X-Y modes.
Claimed Bandwidth (3 dB) = 45 MHz.
Note: x5 multiplier operational in the vertical amplifier claimed bandwidth = 10 MHz
Input impedance 1M; 20pF.
Maximum input voltage 600 V
Delay line: 120 nS
Maximum triggering frequency = 80 MHz
Weight 9.8 kg
Size: 145 x 280 x 422 mm

MAKE A GIFT FROM A KIT

The joy of giving is enhanced when they know you've made it yourself.

HOUSE ALARM KIT - ETI 582

This great kit was released by ETI back in 1977. To make it easier for the constructor we have joined the two PCB's together and added a power supply on the one board.

SPECIFICATIONS

Types of inputs Silent entry, perimeter circuits, internal circuits, emergency circuits.
Silent entry Single circuit, 30 second exit delay, 30 second entry delay.
Perimeter circuits 7 circuits, N/C contacts can be expanded in units of 4.
Internal circuits 4 circuits, N/C contacts, can be expanded in units of 4. Any number of N/O circuits.
Emergency circuits Any number of N/O circuits. These circuits are active even if perimeter and internal circuits are switched off.
Current drain and battery life (type 732) Emergency only 2.5mA (4000 hours); Alarm active 9mA (2000 hours); Alarm sounding 500mA (10 hours)
Alarm time 12 minutes

All components are supplied, including mains transformer, lead, terminal strip, nuts and bolts, but no case. See ETI July/August, 1977.
Cat. KE-4032

ONLY $59.95
(HORN EXTRA)

MICROBOTS® BACK!!

We have secured another shipment of the two most popular Micro Robot kits.

PIPER MOUSE

This 'microbot' is powered by 2 DC motors that drive wheels. When special ultrasonic whistle is blown, the unit goes left, right, straight ahead according to your command.Complete, including perspex dome cover! Be a Pied Piper!
Cat. KJ-6680

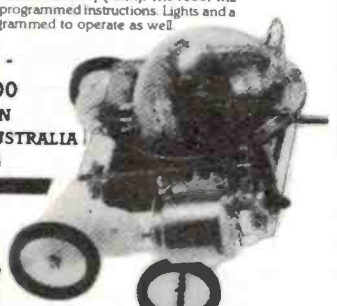
$34.95 - SAVE $5.00

MEMOCON CRAWLER

This robot is controlled by a keyboard (which is supplied). The keyboard plugs into the robot. Up to 256 discrete commands can be entered into the robots memory (RAM). The robot will then move according to programmed instructions. Lights and a buzzer can also be programmed to operate as well.
Cat. KJ-6686

$69.95 - SAVE $10.00

SEE REVIEW IN ELECTRONICS AUSTRALIA MARCH 1984



Ref: EA October 1984

Jaycar and EA have come up with the best value Oscilloscope on the market today - **IN A KIT. . .**

OSCILLOSCOPE SENSATION!

Over the years many people have asked, "Do you have a CRO kit?" Our answer - up until now - has been that built and tested units were no dearer than kits, if you could get a kit at all.
The Jaycar KJ-7050 Cathode Ray Oscilloscope kit has a guaranteed 5MHz bandwidth but should go to around 6.5MHz. It also features 75mm (3") CRT Blue Phosphor with accurate graticule, separate vertical and horizontal BNC type input sockets etc. Remember, a 5MHz 'scope is usually adequate to troubleshoot most micro processor and other digital circuitry as well!
This is a wonderful opportunity to learn electronics AND end up with a valuable piece of test equipment as well.
The Jaycar KJ-7050 kit is absolutely complete. The chassis is pre-punched and every component including nuts and screws are provided, along with instructions.
Cat. KJ-7050

ONLY $229

MUSICOLOR IV

REF: EA AUGUST 1981

The ultimate in lighting controllers. Combines a brand new four channel version of the famous EA Musicolor sound-to-light effect with four channel chaser. This new Musicolor has a host of features rarely seen even on expensive commercial units: ★ Front panel LED display ★ four different chaser patterns ★ auto and manual reverse chase ★ sound-triggered chase ★ inbuilt electret microphone ★ safe, opto-isolated circuitry. And just look at the price!
Cat. KA-1010

$89.90

⅓ OCTAVE EQUALISER - the way to go

Rugged full ⅓ Octave Equaliser in a 19" rack mount case with Cannon Male/Female connections for full professional use. The Jaycar 2801 Mk III has specifications that are unknown in equalisers under the $1,000 price tag! Now is the time to bring your music presentation up to grade with the unsurpassed Jaycar 2801 Mk III (very similar to the 5000 ⅓ Graphic Equaliser).
Cat. KJ-6531

FROM $225

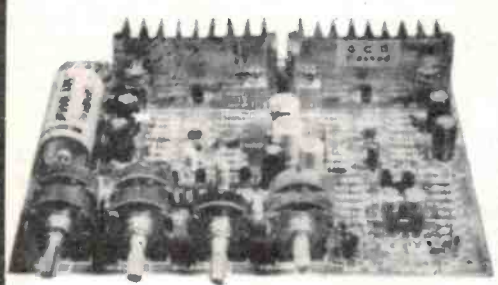
KAISE DIGITAL MULTIMETER SK 6100

Check the specifications/features of this superb Digital Multimeter.

- Autoranging with manual override
- Auto polarity displays - sign when probes reversed
- Overange indication "Blink" and buzzer warning
- Low battery warning BATT sign shows
- Sampling rate 2 times second
- Power supply 2 x A penlight batteries (300 hours continuous operation)
- Fuse protected, spare fuse provided
- Zero adjustment, zero adjust button - a must if you change test probes
- LCD display, magnificent clear readout
- Inbuilt buzzer, available for continuity test, overload warning and switch warning
- Ranges ±1000V DC/600V AC, AC and DC current, resistance 200 (resolution 0.1 ohm) to 2000K ohm (resolution 1K ohm) in 5 ranges autoranging
- Accuracy 0.5% DC, 0.8% AC

Cat. QM-1525

$59.95



Cat. AA-0300

30W + 30W STEREO PREAMPLIFIER

★ Fully built and tested ★ Separate Bass, Treble, Balance and Volume controls ★ Less than 0.1% distortion ★ Mic, Phono and Aux inputs (line) ★ Power supply components on board.

Back at last! No hassle amplifiers. Just connect a transformer, speakers a signal and you're away!

STAGGERING VALUE

ONLY $39.95

FULL 90 DAY WARRANTY

★ NEW IMPROVED MODEL ★

As reviewed in Electronics Australia Oct 1982 & Electronics Today International Nov 1982

Cat. XC-2010

At $199 the Voyager Car Computer represented outstanding value for money. The Voyager is the only low-cost unit that will give youfuel consumption (the most important feature in a car computer) in both metric litres/100km AND good old MPG! At $199 many, many hundreds have been sold. NOW you can grab one absolutely complete for only $125 - a saving of 37% or $74! The Voyager comes complete with all fitting hardware - even down to a roll of insulation tape! Installation generally takes between 4 and 6 hours depending on vehicle.

SPARE FLOW SENSORS To avoid problems when changing cars, why not buy a spare fuel flow sensor? They are about the only thing that can wear out.

Cat. XC-2036 ONLY **$29.50**

ONLY $125 COMPLETE

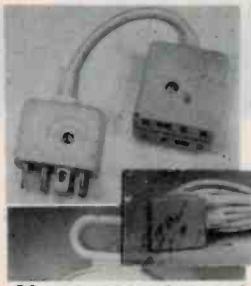
MASSIVE SAVING OF $74

BELOW MANUFACTURER'S COST!!

The Voyager is available from the following dealers at your convenience.

★ ALL JAYCAR STORES AND BY MAIL ORDER: JAYCAR P.O. Box 480 Auburn 2144 ★ ZAP ELECTRONICS (all stores) ★ ROD IRVING (Melbourne 347 9257 or Northcote 489 8131 ★ ALTRONICS (Perth 328 1599)

AT LAST! LOW COST TELEPHONE EXTENSION CORDS!



Telephone socket double adaptor

Cat. YT-6020 **$19.95**

Suitable for PABX (10 metre length)

20 metre extension cord

Cat. YT-6014 **$24.95**

10 metre extension cord

Cat. YT-6012 **$19.95**

5 metre extension cord

Cat. YT-6010 **$14.95**

80 CPS Printers Are Out!! The New Micron 100 CPS is in

★ ULTRA SMOOTH QUIET OPERATION

SENSATIONAL PRINTER!!

$379

FEATURES: ★ Extra fast 100 characters per second ★ 192 ASCII characters (96 standard, 96 italic) ★ Bit image graphics ★ Friction and sprocket paper feed (100mm to 254mm paper) ★ Columns - normal/80, condensed/142, enlarged/40, condensed double width/71, elite/96, enlarged elite/48. ★ Logic seeking - bidirectional.

Cat. XP-4630

SCOOP PURCHASE of 4 COLOUR PRINTER/PLOTTERS!!

DON'T PAY

~~$299~~

~~$229~~

~~$169~~

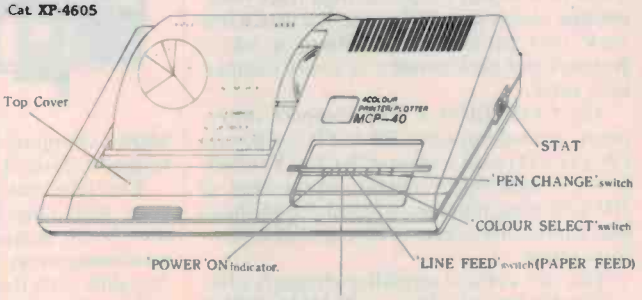
$149

Cat. XP-4605

Jaycar has done it again! We have made a scoop purchase of 4 colour printer/plotters at a never-to-be repeated price!! The SAME printer has sold elsewhere for up to **$299** but currently sells for as low as $169. At $169 it is an absolute bargain! (See specs). Now Jaycar can offer you the SAME printer for $149!!How do we do it? We have bought BELOW IMPORTERS COST and have passed the SAVINGS on to you!

QUANTITIES STRICTLY LIMITED. We have less than 80 pcs in stock at the time of going to press. To avoid disappointment, we suggest that you ACT QUICKLY.

The printer/plotter is supplied with mains lead, a roll of paper 114mm x 55m long (4.5" x 180') and a set of 4 pens (black, blue, red & green). Spare rolls and pens are available from other major electronic suppliers and for a short time, us



Cat. XP-4606 Spare Paper Rolls $3.30

Cat. XP-4607 Set of 4 Pens $7.50

Sparkrite

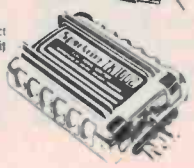
The Brandleaders in Auto Electronics

SPARKRITE SX2000 ONLY $59

Reactive Discharge electronics combining all the advantages of both Inductive and Capacitive Discharge for maximum spark performance. Fits all 12V negative earth vehicles utilising coil and contact breaker ignition.

Cat. KJ-6650

SPARKRITE TX1002



An Inductive Discharge System which can be used with existing contact breakers or with the Hall Effect Triggerhead system. A top quality unit from the U.K.

Cat. KJ-6651

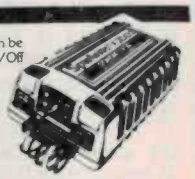
ONLY $79

SPARKRITE TX2002

A Reactive Discharge System with unique auxiliary circuit which can be switched in via the three position switch on the unit itself - Electronic/Off /Aux'. Only four connections are necessary and it's fitted!

Cat. KJ-6652

$115



SPARKRITE AT-80 VALUE AT $99

This unique alarm does not need holes to be drilled in your cars body - a special sensor pad is attached to the inside of your windscreen and you gain entry through your own programmed magnetic key fob. The sensor pad even flashes a light when your code has been accepted and the code can be reprogrammed at any time.

Cat. KJ-6660

EA WIDEBAND AM TUNER - Ref: EA Dec/Jan 1982/1983

This is a true broad-bandwidth superhet design AM tuner kit suited most admirably to Australia. Jaycar have produced a superb kit that includes a pre-punched cabinet.

Cat. KA-1498 **ONLY $249**

Alignment kit for EA Tuner - Cat. KA-1515 **ONLY $7.95**

CQAM STEREO DECODER KIT - Ref: EA October 1984

Set of parts for this project including PCB, 10uH choke, MOC13020 IC. (Whistle filter coil extra - Cat. EE-3814 ONLY $19.95)

Cat. KA-1555 **ONLY $19.95**

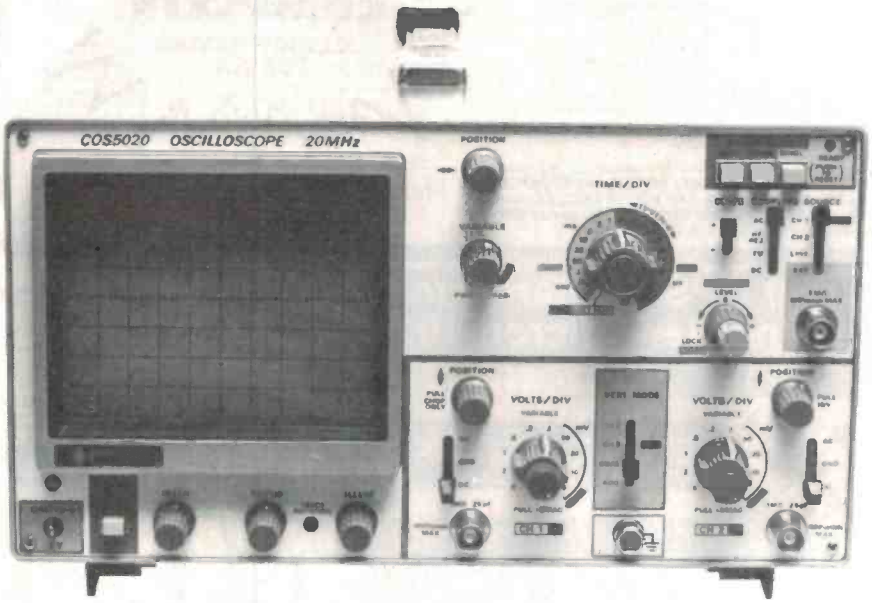
Jaycar ELECTRONICS

SEE OUR OTHER ADS FOR ADDRESS PANEL AND OTHER INFORMATION — PAGES 25 & 85

COMPACT CRO — 20 MHz, dual trace.

Jim Rowe

The Kikusui Model COS5020 oscilloscope is a compact dual trace instrument offering 20 MHz bandwidth in each channel, together with all the usual facilities. It has a flat 100 x 80 mm screen and comes complete with two switched and compensated test probes.



THE KIKUSUI Electronics corporation of Japan has been making measuring instruments for many years, but in Australia at least they seemed to 'go quiet' for a while. Their new model COS5020 dual trace oscilloscope seems set to bring the Kikusui name back into prominence, offering a lot of features and performance at a very competitive price.

The COS5020 is a very compact instrument, measuring only 285 x 175 x 440 mm (W x H x D) with a mass of 7.1 kg. Yet it offers a screen with a useful display area of 100 x 80 mm, together with all the facilities you'd normally expect in this kind of laboratory 'scope.

The two vertical amplifier channels offer a bandwidth of dc — 20 MHz within −3 dB, with a sensitivity of 5 mV/division and for displayed signal amplitudes as large as 80 mm p-p. The upper corner frequency of both channels falls to 15 MHz when the x5 multiplier switch is engaged, giving a sensitivity of 1 mV/div. Rise times are 17.5 ns for the normal settings and 23 ns for the x5 settings. Vertical linearity is quoted as better than 0.1 of a division for a waveform of 2 div p-p moved to either limit. Both channels have attenuators which switch from 5 mV — 5 v/div in the usual 1-2-5 sequence. Input impedance is 1 M in parallel with 22 pF.

Vertical display modes provided are CH1, CH2, dual and CH1+CH2 (algebraic addition). In the dual mode, switching is chopped (at approximately 250 kHz) for sweep speeds up to 1 ms/div, normally changing to alternate traces for higher sweep speeds. However a 'chop only' switch allows chopping to be used for all sweep ranges if desired.

The time base is of the fully triggered type, with ranges from 0.5 s/div to 200 ns/div. A x10 magnification switch allows the maximum sweep speed to be increased to 20 ns/div. All the normal triggering modes and facilities are provided, including 'auto' and single shot. Internal triggering sensitivity is better than 1.5 minor divisions up to 20 MHz, with external sensitivity of less than 200 mV p-p.

The COS5020 is fitted with an integral-graticule flat-face rectangular CRT, running with 2.2 kV of acceleration voltage. This gives a very bright, crisp trace even at the fastest sweep speeds. A 'trace rotation' screwdriver adjustment is provided to allow accurate matching of the traces to the graticule axes. Also provided is a 'calibrate' output providing a 1 kHz squarewave signal at 2 V p-p.

All input connections on the COS5020 are via standard BNC-type sockets, including the Z-axis input at the rear. For convenience the instrument comes with both screw-terminal adaptors for the vertical inputs, and a pair of switched x1/x10 test probes. The probes are compensated, with trimmers built into the BNC plug shells; they also have screw-on hook adaptors and clip-on earth leads. With many instruments, these would cost you $30-$40 extra.

A quick check of the sample instrument pictured showed that it met the quoted specs easily, and performed very smoothly. It also seemed to be very sturdily made. The only fault we could find, and it's a very minor one, is that the illumination for the screen graticule is rather uneven. But all in all, the instrument seems to us very good value indeed for the quoted price of $625.25 including tax.

The Kikusui COS5020 is available from **Geoff Wood Electronics Pty Ltd, 656A Darling Street, Rozelle 2039. (02)810-6845.** ●

SPECIFICATIONS AT A GLANCE

100 mm x 80 mm screen
2.2 kV accelerating voltage
CH1, CH2, Dual Add, Chop and X-Y mode; claimed bandwidth 20 MHz.
15 MHz with x 5 multiplier
Input impedance −1 M/22pF.
Weight 7.1 kg
Size: 285 x 175 x 440 mm

ALTRONICS
★ MONEY BACK PLUS $5.00 GUARANTEE

Dear Customer, At Altronics we are continually trying out methods of improving our range of quality products and the high standard of service we offer our Shop, Mail and Phone order customers. I believe our future prosperity will be a direct reflection of the standards of service we have adopted. So for November and December 84 we pledge that if you find our products and/or service is not as we claim you may return your purchase to us for a **full refund plus $5.00** for your inconvenience (mail/phone order customers please allow transportation costs)

Regards

Jack O'Donnell

THE DAZZLING MUSICOLOR IV PROJECT

Combination Colour Organ and Light Chaser. Four channel colour organ. Internal micro-phone or connect to speakers for colour organ operation. (The lights connected to each channel pulse in beat to the music proportional to portion of frequency spectrum concerned.) Four chaser modes forward and reverse. Output lamp load capacity a massive 2400 watts — that's 100 party globes. Full instructions and every last nut and bolt included. Great for parties, shop signs, display windows etc.

K5800 ..... **$89.50**

MICROWAVE OVEN LEAK DETECTOR

ETI PROJECT

Completely passive project receives microwaves via an antenna which develops a voltage across a detector diode driving the meter.
Monitor your microwave oven with this easy to build kit. All components mount on single PCB, including the meter.
Genuine Hewlett Packard Hot Carrier Diode supplied.

K1724..... (still only) **$14.50**

LED BARGRAPH PEAK DISPLAY

This easy to build level meter uses our exclusively imported LED bargraph module which gives it a very professional finish indeed. Indicates from —21dB to + 6dB using a logarithmic scale. **Great Value!**

K 5412..... **$16.50**

★ KIT SUPPORT FOR THE MICROBEE ★

MICROBEE IS A REGISTERED TRADEMARK OF APPLIED TECHNOLOGY PTY LTD

MULTIPROM INTERFACE

44K OF PROGRAM STORAGE

A sensational new kit for the MICROBEE, requires no modification to the computer except for the fitting of a 50 pin expansion socket. This project is easy to build and will allow you to store and software select up to 44K of eprom storage — acts like a mini disk drive system with the speed of RAM. Extra units may be added to further increase storage.

THE MICROBEE® KIT OF 1984

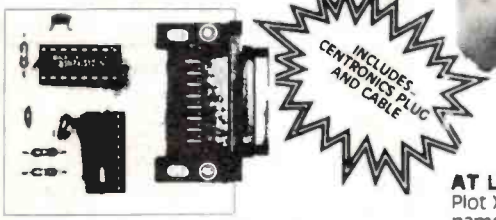
K9673..... **$99.50**

PARALLEL INTERFACE

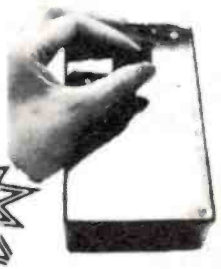
BUILD YOUR OWN INTERFACE AND SAVE $$$

A simple kit to build — takes about 20 minutes, save on the cost of a built interface and save the cost of a serial printer.

K9671..... **$29.95**



PROPORTIONAL JOYSTICK



SELF CENTERING

K9674

$32.50

(ETI DEC 83)

FOR THE BEE!

AT LAST AN ANALOGUE JOYSTICK

Plot X-Y co-ordinates on the screen, sign your name. A great graphics aid. Complete kit **including case,** software example.

EPROM PROGRAMMER

(ETI JAN '83)

K9668..... **$55.00**

Versatile, low cost and easy to build. Plugs straight into the microbee I/O port. Suitable for 2716, 2732, 2532, 2732A and 2764 Eproms. Burn your games programmes and eliminate cassette loading time.

KIT FEATURES Sockets for all other ICs 1 x 2716 supplied — get started straight away. Front Panel and Mains ISEC approved transformer. 28 pin and 16 pin wire wrap sockets to flush mount personality plugs (2 included) and ZIF socket included. DB 15 Plug. Complete to last nut and bolt.

(See Review ETI AUGUST 1983)

RADIOTELETYPE DECODER

(ETI APRIL '83)

K9733..... **$19.50**

Display RTTY encoded messages on your Video Monitor. Receive up to date weather information, international News before the Papers, all sorts of coded military info. Simple circuit uses PLL techniques. Single PCB Construction. Kit includes DB15 Plug and backshell for connection to microbee. Shielded pretinned PCB.

MICROBEE LIGHT PEN

NEW

(ETI AUGUST '83)

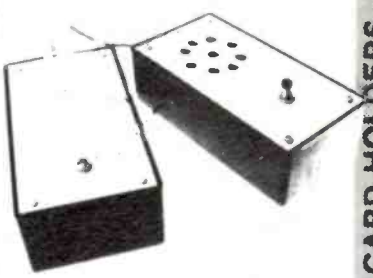
PROVIDES DIRECT PERSONAL CONTACT WITH YOUR BEE!

K9649..... **$19.95**

AT LAST — a light pen for the Bee. This pen works in the low-resolution graphics mode and connects directly to the I/O port • Complete kit including DB15 2m CORD • Fully documented with software example.

FAX-DECODER

(ETI SEPT '83)



K 9763..... **$24.50**

This project allows you to decode the signals of shortwave stations transmitting radio facsimile weather maps, satellite pictures etc. and then reproduce them on your dot-matrix printer.

- Complete kit of parts includes DB15 Ribbon Cable
- SOFTWARE LISTING

7 DIGIT FREQUENCY COUNTER

UNBELIEVABLE 0.005% ACCURACY

☆ **Frequency and Period measurement to 500 MHz (with optional prescaler)** ☆ **High input sensitivity. Professional unit at a fraction of the cost of built up units.**
☆ IC sockets provided throughout ☆ Low age rate 10.000 MHz XTAL ☆ Quality ABS plastic case with deluxe Front panel ☆ Specified LSI.

K2500..... **$119.50**

PRESCALER
K2501..... **$26.00**

DECIMAL POINT
K2502..... **$7.50**

FUNCTION GENERATOR

The most essential piece of test gear (second only to a good multimeter) on any hobbyist's bench is some kind of audio signal generator. This design utilizes the latest circuit techniques to produce stable, low distortion waveforms.

A truly versatile unit at a bargain price.

☆ 4 digit frequency readout (eliminates tiresome dial calibration) — typical accuracy ± 2% ☆ 3 overlapping ranges x1, x10, x100 ☆ 600 OHM Nominal Output — continuously variable 3MV — 2.5V P-P ☆ Distortion — sinewave : less than 0.7% @ 1KHz ☆ Linearity — triangle wave: better than 1% @ 1KHz ☆ Squarewave rise time — 6V/uz maximum output ☆ Amplitude stability — better than 0.1dB on all ranges.

K2505..... **$85.00**

DIGITAL CAPACITANCE METER

NEW DELUXE FINISH

We are pleased to announce the release of the Digital Capacitance Kit housed in our Deluxe H0480 ABS Instrument Case.
This superb Test Instrument kit now compliments our top selling Digital Frequency Counter and Function Generator Project Kit. Electronics Australia Project. Measures capacitance of both polarized and non-polarized capacitors from 1 picofarad to 99.99 microfarads in 3 ranges.
Check values of unmarked capacitors, especially those little trimmers that are never coded.
Select precise values for filters and timing networks within ease.

☆ **EXCLUSIVE TO ALTRONICS** ☆
Each kit includes precision measured capacitors for accurate calibration of each range.

K2521..... **$55.00**

VIDEO AMPLIFIER

Brilliant new kit from EA, **Super cheap** and **Super Effective.** Whilst our K5830 is suitable primarily for VCR use this video amplifier is best suited to use with computers. The EA documentation supplied is extremely well written and provides details for installation into television sets.

NO MORE SMEARY COLOURS, SIGNAL BEATS OR RF INTERFERENCE

K5850..... **$14.95**

VIDEO ENHANCER

Here's a **simple** but **effective** Video Enhancer that is super **easy to build** at a fraction of the cost of commercial models.
Unit sharpens picture detail, and can actually improve the quality of a copy by amplifying the top end of the video signal.

AT LAST A VIDEO ENHANCER KIT

K5825..... **$35.00**

VIDEO RF MODULATOR

(SEE ETI OCT 1981)

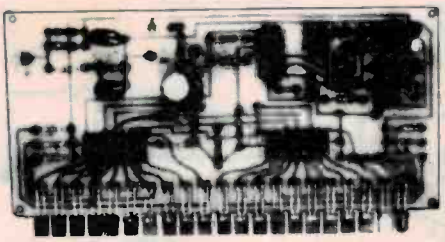
If you cannot afford a Video Monitor for your computer this is the kit for you. Super stable oscillator design and very low modulation distortion ★ Works with both B & W and Colour TV sets ★ Suitable for computers, TV games, TV pattern generators or what have you. Deluxe kit featuring heavy duty diecast box for RF shielding ★ Input and output sockets.

K 9760..... **$17.50**

MONITOR AND IMPROVE VEHICLE PERFORMANCE

TWIN RANGE LED TACHO

(SEE ETI AUGUST 1980)



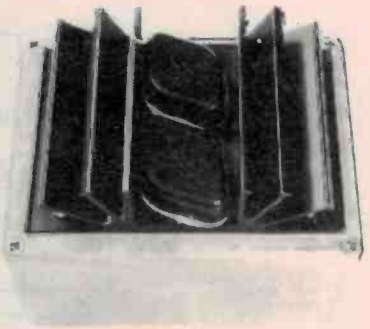
Unit suitable for 1, 2, 3, 4, 6 and 8 cylinder vehicles, 2 stroke or 4 stroke ★ fully compatible with conventional, CDI and transistorized ignition systems ★ Includes protection circuitry to prevent noise and high voltage spikes from the points and coil circuit damaging the electronics. ★

Display flashes when over-reving occurs ★ only 3 connections required to electrical system.

Check The Performance of Your Vehicle At A Glance!

K4324..... **$24.50**

TRANSISTOR ASSISTED IGNITION WITH DWELL EXTENSION



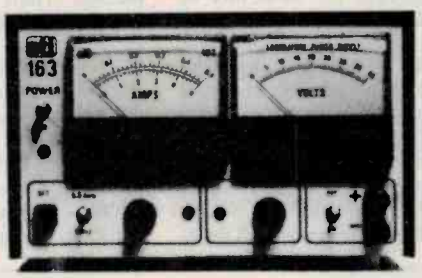
The Altronics Kit includes all components for the modifications, detailed by Electronics Australia Feb. 1983.

Yes, it's bad enough paying $2.00 a gallon for petrol without wasting a fortune on an out of tune engine. Fit this transistor assisted ignition kit in minutes and start saving money from the very next petrol stop. Easy to build!

K4010..... **$35.00**

0-40 VOLT/5 AMP LAB SUPPLY

(SEE ETI MAY & JUNE 1983)



FEATURING: VARIABLE CURRENT LIMIT- DUAL METERING

A Laboratory Supply requires specifications second to none. **This Supply has them!**

Output voltage	0-40 V, variable
Output current	0-0.5 A, variable limiting 0-5 A, variable limiting
Output regulation	<50 mV at up to 2.5 A <100 mV up to 5 A
Maximum output power	200 watts
Metering Voltage	0-40 V in 1 V divisions
Current	0-0.5 A in 20 mA divisions 0-5 A in 200 mA divisions

Series regulator design enables design and development of sensitive high gain audio and RF circuitry free from hum and noise sometimes associated with other techniques.

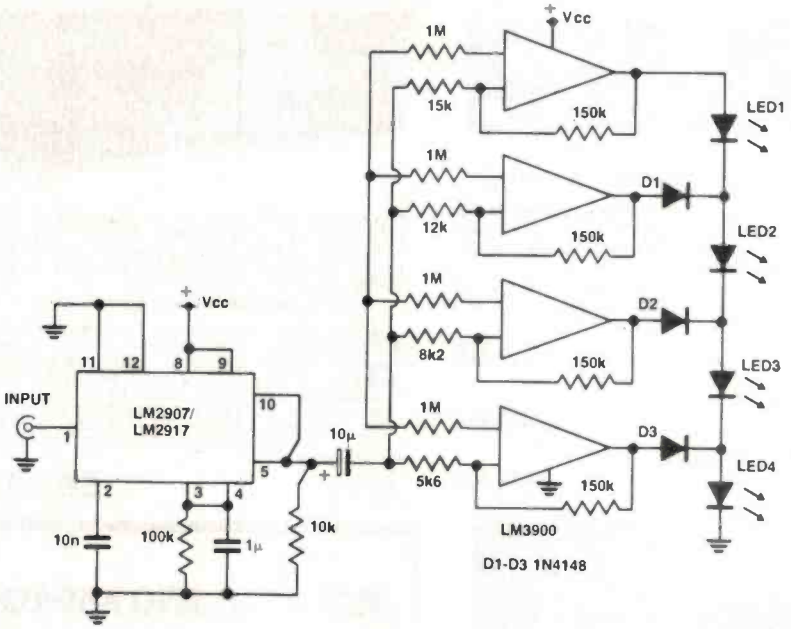
K3325..... **$175.00**

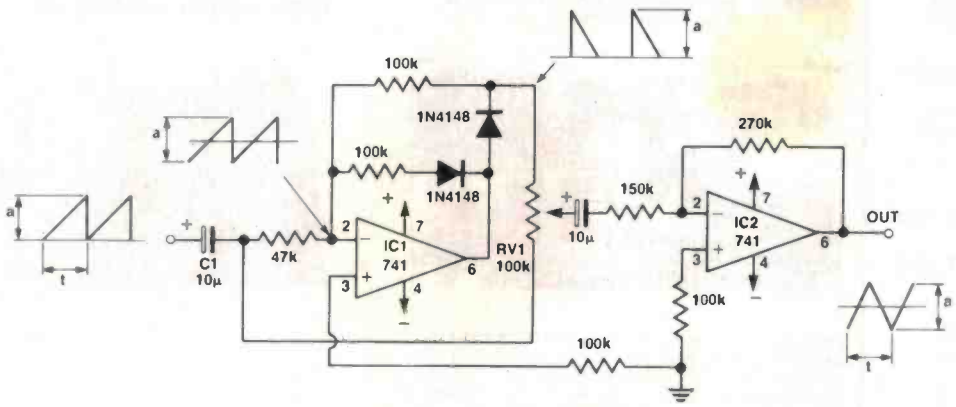
PHONE YOUR ORDER — ALTRONICS TOLL FREE 008 • 999 • 007

Bargraph display

The advantage of measuring an audio signal with its frequency and not its volume is that the LEDs aren't affected by the loudness of the output. This means that they will work just as well at any volume. This simple circuit from **M. Sorel of Clarence Park, SA,** has just two ICs. The LM2907/2917 is a frequency-to-voltage converter.

The LM3900 is a quad Norton op-amp, used as the level-indicator. Capacitor C1 may be changed to suit the voltage or desired range. Red LEDs should be used, and should be as similar as possible. The voltage range is 5 to 25 V. This circuit is small enough to fit inside most equipment.





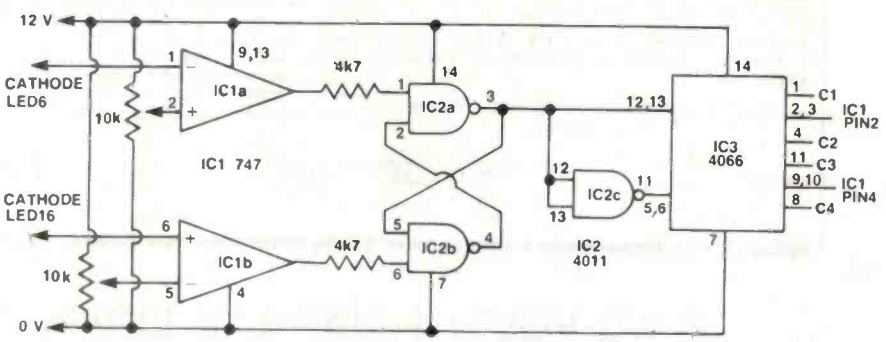
Sawtooth-to-triangle wave converter

This circuit from **Justin Roff-Marsh of Esk, Qld,** converts a sawtooth waveform to a triangle wave of the same frequency.

Any offset voltage is removed by C1. The circuit around IC1 removes the positive part of the waveform, the negative being inverted and multiplied by two. RV1 and IC2 mix the waveform after C1 with the rectified, inverted and doubled waveform. RV1 is adjusted for a correctly shaped output. This can either be done with an oscilloscope, or it can be adjusted by ear for the purest output tone.

The input waveform can either have slow attack or slow decay, but for good results the flyback time should be as low as possible (anything below about 20 µs is inaudible).

This circuit can be used as a linear fullwave rectifier for any waveform. If the input is a triangle wave it functions as a frequency doubler.



Tacho modification

Bill Kennan of West Heidelberg, Victoria, sent us this modification to the LED tacho project (ETI-324) we published in August 1980.

To increase the flexibility of the unit it has two ranges, one for low speed, one for high. There is a manual switching facility that allows the operator to choose between the two. Mr Keenan's idea does away with this manual switch.

Flying leads from the cathodes of LEDs 6 and 16 are fed to the inputs of the dual 747 comparator. Their voltage levels are compared to the preset voltages produced by RV1 and RV2. RV1 adjusts the low revs and RV2 the high range.

The outputs are fed to the 4011, wired as a flipflop. The Q and Q output from here are fed to the 4066, wired as a DPDT switch, which eliminates the switch in the original circuit.

IDEA OF THE MONTH

Digital servo controller

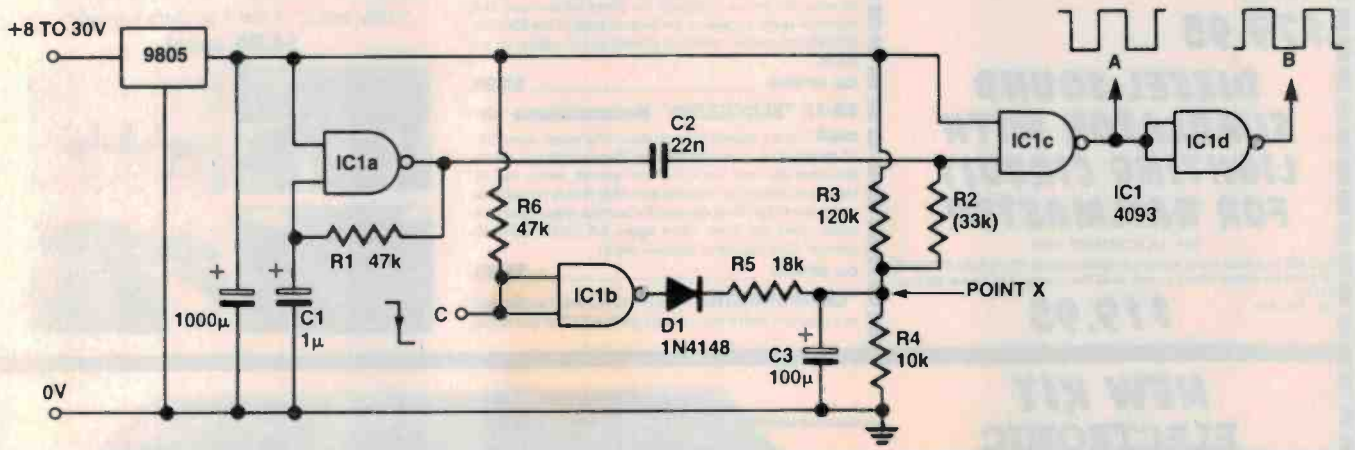
T. J. Threlfall, Shenton Park WA

This circuit uses a form of simple pulse width modulation to control a servo motor. The idea is to feed the servo a series of pulses, the operation of the servo arm being determined by the frequency and duration of the pulses.

IC1a forms an astable running at about 70 Hz. This triggers IC1c, which lengthens the pulses by a time determined by C2 and R2. IC1d may be fitted to invert the pulses.

The degree to which this pulse lengthening occurs is determined by the voltage at the end of R2. Initially, this is determined by the voltage divider composed of R3 and R4. This remains true so long as the diode D1 is reverse biased and R5 is effectively open circuited. However, if the output of IC1b goes high it pulls the voltage on the divider up, so increasing the pulse width. The output of IC1b is controlled by the point C. Since IC1b forms an inverter, and since point C is normally pulled high by R6, the output is normally low. C is driven low with a mechanical switch or some external logic.

With the values shown the pulse width varies between 0.9 ms and 1.9 ms. Most servos can be used with pulse widths between 0.7 ms and 2 ms. The pulse rate can be as high as 200 Hz and as low as 1 Hz. However, at very low frequencies the motion of the servo will probably become a little jerky.



'IDEA OF THE MONTH' CONTEST

COUPON

Cut and send to: **Scope/ETI 'Idea of the Month' Contest, ETI Magazine, P.O. Box 227, Waterloo NSW 2017.**

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

* Breach of copyright is now a criminal offence.

Title of idea .....

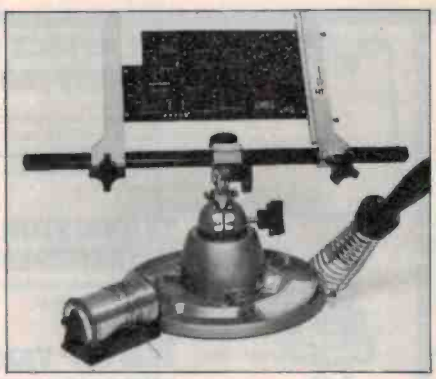
Signature .....

Name .....

Date .....

Address .....

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



PRIZE WORTH $123!

Scope pc board Work Centre

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 pc board Work Centre consisting of the Model 315 adjustable pc board holder with capacity to accept 300 mm boards, Model 300 180° swivel and lock base which can be attached to the Model 312 tray base with wet sponge receptacle, Model 371 solder spool holder and Model STS 3 soldering iron safety stand. Please note prize does not include solder or scope TC60 temperature controlled iron shown above. The prize is worth $123!

Selections will be made at the sole discretion of the editorial staff of ETI Magazine. Apart from the prize, each winner will be paid $10 for the item published. You must submit original ideas of circuits which have not previously been published. You may send as many entries as you wish.

RULES

This contest is open to all persons normally resident in Australia, with the exception of members of the staff of Scope Laboratories, The Federal Publishing Company Pty Limited, ESN, The Litho Centre and/or associated companies.

Closing date for each issue is the last day of the month. Entries received within seven days of that date will be accepted if postmarked prior to and including the date of the last day of the month.

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 same day the result is declared. 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 entry form. Photostats or clearly written copies will be accepted but if sending copies you must cut out and include with each entry the month and page number from the bottom of the page of the contest. In other words, you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

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.

MAKE A GIFT FROM A KIT

The joy of giving is enhanced when they know you've made it yourself

RAILMASTER KIT

REF: EA SEPTEMBER 1984

This is the most up to date train controller kit we've seen in a long time. It offers all those wanted features including inertia, full overload protection and walk around throttle. Kit includes front panel, correct console box and all parts.
Cat. KA-1560

$79.95

DIESEL SOUND SIMULATOR WITH LIGHTING CIRCUIT FOR RAILMASTER

REF: EA NOVEMBER 1984

You will be amazed how authentic this kit sounds. Kit includes PCB and all parts for sound effects as well as all the components for the lighting circuit.
Cat. KA-1561

$19.95

NEW - "HI-TECH" WALL POSTERS

A departure from our area of electronic hardware, but we think that you will be as impressed as we were when you see these magnificent posters. Shown below are descriptions of a small range of posters. We may increase this range depending on the response.

BOEING 767 COCKPIT A magnificent wide-angle view of a new Boeing 767 flight deck on the tarmac at dusk. The photograph is taken from the entrance to the flight deck. In the foreground is a clear view of the new all-electronic instrumentation which is a feature of this aircraft. On the far right is the engineer's console. A typical airport runway can be seen through the pilots windscreen. Full technical specs appear on the bottom edge of the 530(H)x 825(W)mm poster, which is printed in full colour on art paper.

Cat. BP-9210 _____ $5.95

SR-71 "BLACKBIRD" Reconnaisance aircraft This is a superb front-on shot of the super-secret SR-71 standing on a remote runway. The photograph clearly illustrates the very low Cd of this aircraft, which can fly higher and faster than virtually any other. A truly remarkable example of High-Tech despite the fact that it was designed many years ago now. Once again, full 530(H)x825(W) colouor. (The aircraft is painted black).

Cat. BP-9212 _____ $5.95

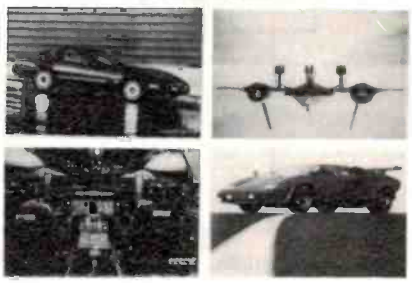
"LAMBORGHINI" How could you ever be upstaged in a Lambo? Well if you haven't got the $A200 grand that one will cost you here you can have a magnificent poster of a red Countach for $5.95. This 530(H)x825(W)mm poster shows this classic vehicle contemptuously parked across the yellow line of a lonely road.

Cat. BP-9214 _____ $5.95

"CORVETTE" This is a photograph of the 1984 model Corvette. This model was completely re-engineered and is a major departure from conservative engineering practice. Many European style mechanical features around. It is rumoured that they may arrive in Australia in numbers... We think that it is the best-looking example of the marque yet. The car is painted in black against a red background. 530(H)x825(W)mm.

Cat. BP-9216 _____ $5.95

Buy any 2 of the 4 posters for only **$4.95 each!**



NEW KIT ELECTRONIC CROSSOVER

REF: EA NOVEMBER 1984

This much sought after kit is now finally available. The unit is for stereo with 2 crossover points for each channel for 3 way speakers.
Commercial units are almost double the price.
Kit comes complete with silk screened, track front panel and quality English made Lorlin switches.
Cat. KA-1570

$199

BRAKE LAMP FLASHER

This little device will flash accessory brake lights three times when the brake pedal is depressed. If you've had a rear end collision you will know how handy this device is.
PCB and components only. REF: EA NOVEMBER 1984
Cat. KA-1564

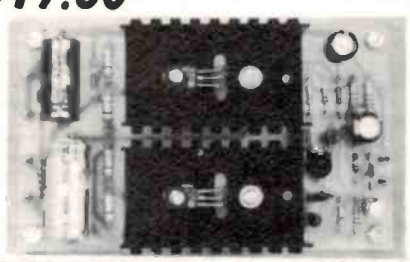
$16.50

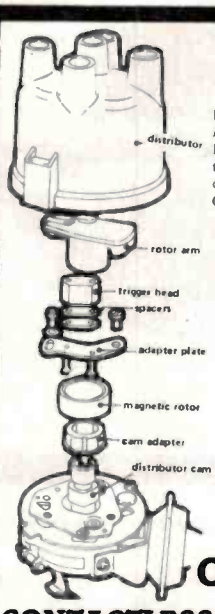
20 WATT LOW COST AMPLIFIER

Ref: EA NOVEMBER 1984

This amplifier module uses only a handful of parts and is simple to build. Kit includes pre-drilled heatsinks which mount on the board.
Cat. KA-1567

$17.50





HALL EFFECT SWITCH VANE INTERRUPTED $19.95

If you have a car that won't take the Jaycar KJ-6655 Hall Effect Kit (i.e. an Australian six or V8) this could be for you!
It is the SIEMENS (German) made Hall Switch. It will operate from −30 to +130°C. A simple soft iron vane cut with appropriate slots will commutate the unit.
Cat. HK-2101

PCB to suit 84T19 $3.45

TRANSISTOR ASSISTED IGNITION HALL EFFECT "BREAKERLESS" VERSION - $36.95

This kit is virtually identical to the KA-1506 except that it contains the interface electronics for the KJ-6655 Hall Effect Triggerhead.
Cat. KA-1505

NEW! VANE INTERRUPTED HALL EFFECT SWITCH INTERFACE!

Ref: EA September 1984

This upgrade kit enables you to convert your existing points-type Transistor Assisted Ignition to the new Siemens Vane Interrupted type (i.e. for Australian 6 cylinder & V8's).
The upgrade kit includes new PCB and conversion components. The other components come from your existing TAI.
Cat. KA-1503

ONLY $4.95

Cat. KJ-6655

ONLY $29.95

CONTACTLESS HALL EFFECT "BREAKER POINTS"

REF: EA DECEMBER 1983

A professionally engineered electronic ("breakerless") contact breaker system. Jaycar has the complete Hall Effect triggerhead assembly designed to adapt to an extensive number of cars. Each kit contains the following: ★ Hall Effect triggerhead ★ Magnetic rotors for both 4 and 6 cylinder cars ★ Over 6 cam-lobe adaptors ★ Over 12 different adaptor plates for your particular distributor ★ Other hardware (i.e. screws etc) ★ As easy to install as a set of points ★ Simple instructions for fitting included.

TRANSISTOR ASSISTED IGNITION $35

REF: EA JANUARY 1983

Latest version of this fantastically popular kit! The Jaycar kit comes COMPLETE down to the plastic TO-3 transistor covers, genuine heatsink and diecast box - as used in the original EA unit.
Beware of flimsy kits that use sheetmetal boxes! This kit is designed to be used with contact breaker points, if you want Hall Effect breakerless option may we suggest the KA-1505 listed above.
Cat. KA-1506

5000 POWER AMPLIFIER

"BLACK MONOLITH"

REF: ETI JAN/MARCH 1981

COMPLETE "BLACK MONOLITH" KIT ONLY

Cat KE-4200 **$319.00**

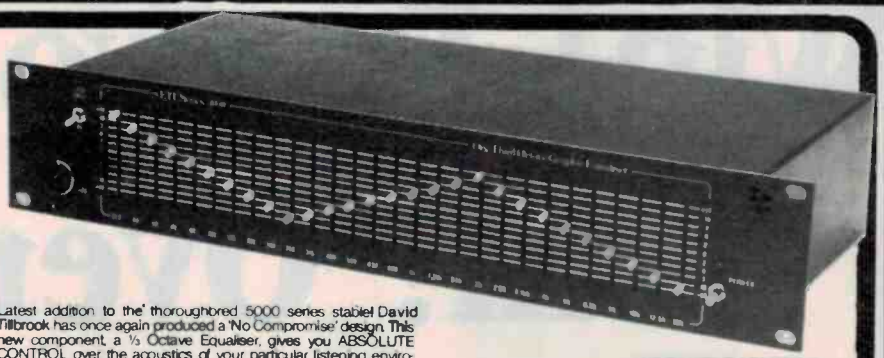
"BLUEPRINT"

REF: ETI JUNE/OCTOBER 1981

5000 CONTROL PREAMPLIFIER **$299**

FOR THE COMPLETE KIT

Cat KE-4202



Latest addition to the thoroughbred 5000 series stable! David Tillbrook has once again produced a 'No Compromise' design. This new component, a ⅓ Octave Equaliser, gives you ABSOLUTE CONTROL over the acoustics of your particular listening enviroment. You get 3 SEPARATE CONTROLS for each and every octave of audio bandwidth to virtually eliminate the subtle nuances that are particular to your listening area.

⅓ Octave Equalisers have been used by professional engineers in Recording Studios and live concerts for over a decade now. It is no accident that the advent of the ⅓ octave equaliser and studio quality live sound recording have gone hand in hand.

BUT FOR YOU THERE'S A CATCH!!

For Hi Fi stereo one of these units is not enough. They are mono so you will need one for each channel. Quite a lot of money really, but worth it if you want the best. Remember that whilst this unit is designed to operate in the 5000 system it will work with other Hi Fi equipment, line level in, line level out.

The Jaycar kit includes a fully pre-punched plated chassis, pre-punched heay gauge front panel silk-screened to match the other 500 components. It is absolutely original but includes such refinements as quality I.C. sockets, UNBRAKO socket head fixing screws, and brushless-look toggle switches.

You can purchase the kits one at time at $199 each or, two, $389 - a $10 saving.

If you are one of the hundreds of happy 5000 users we are convinced that you will be just delighted with this unit.

Cat KE-4204

SPECIFICATIONS

SIGNAL TO NOISE	−102dB with respect to 1 Volt
FREQUENCY RESPONSE	12Hz - 105kHz to −1dB
BOOST/CUT	14dB (28dB total)
DISTORTION	100Hz - 0.007%
	1kHz - 0.007%
	10kHz - 0.008%
	(essentially irrespective of cut or boost)
CURRENT COMSUMPTION(DC)	Approx. 100mA @ ±15V (requires 30V AC CT)
	Output short-circuit proof

FEATURING THE FANTASTIC 5534 IC AND STATE-OF-THE-ART J-FET OP AMPS

ONLY $199

ELECTRIC FENCE

Ref: EA September 1982

$15.00

Mains or battery powered,this electric fence controller is both inexpensive and versatile. It should prove an adequate deterrent to all manner of livestock. Additionally, its operation conforms to the relevant clauses of Australian standard 3129. (Kit does not include automotive ignition coil which is required).

Cat. KA-1109

50/500MHz DIGITAL FREQUENCY COUNTER

Ref: EA Dec 1981/Feb 1982

High performance kit that uses just 5 IC's to measure periods and frequencies up to 500MHz. Everything about the Jaycar kit is special from its gold plated BNC input connectors thru to the special pre-punched heavy plastic front panel that is silk screened in epoxy ink. The standard kit works to 50MHz.

Cat. KA-1390

ONLY $119

A 500MHz prescaler kit - fits directly onto main circuit board in above unit.

Cat. KA-1392 **$29.50**

12/230V - 300W INVERTER Cat. KA-1114

This unit provides up to 300VA of power at 235V from an ordinary car battery. It is ideal as a standby AC power supply. The output is voltage regulated, gives a precise 50Hz and has current limiting with ultimate thermal shutdown. The Jaycar kit features quality conservatively rated components and is complete down to the case and front panel.

REF: EA JUNE 1982

$195

3-50V/5 AMP VARIABLE POWER SUPPLY $149

Ref: EA May/June 1983

A brand new efficient design provides regulated high power. It features state-of-the-art switchmode techniques, dual meters and continuous adjustment. All parts for the kit are provided including specified case, front panel and special meter scales.

Cat. KA-1520

This kit represents a massive saving over equivalent built units! ± 12V add-on kit (refer EA July 1983)

Cat. KA-1521 **$14.95**

★ NEW ★

"SQUEAKY CLEAN" MAINS FILTERS

Two fantastic low cost models. MS-4010 will supply up to 4 appliances. Each 240V socket is isolated from the other, i.e. interference from disc drives is de-coupled from the CPU power supply etc.

It will supply up to 4 outlets with a total load of 6 amps (unswitched)

Cat. MS-4010

ONLY $99

Single 10 amp line-socket type filter (unswitched).

Cat. MS-4012

ONLY $29.95

DUAL TRACKING ±22V POWER SUPPLY

Ref: EA March 1982

This versatile dual polarity (dual tracking) power supply kit can provide up to ± 22 volts at up to 2 amps. In addition the supply features a fixed +5V at 0.9A output. The supply is completely protected against short circuits, overloads and thermal runaway.The kit comes complete with case,meter and front panel.

ONLY $89.50

Cat. KA-1410

Jaycar ELECTRONICS

Incorporating ELECTRONIC AGENCIES

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HURSTVILLE: 121 Forest Road. Tel: (02) 570 7000

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$50 - $99.99	$6.50
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Look at these

A complete HF amateur radio station — including

- The fabulous Yaesu FT757GX all-band all-mode transceiver: THE radio!
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- The superb Yaesu FC-757 microprocessor controlled automatic antenna tuner
- Yaesu accessories FIF232C computer interface, FRB757 Relay Switching Box, FAS-1-4R antenna selector
- V5JR vertical antenna – ready to erect
- 100 metres RG-8 (UR67) Hi-grade co-ax

TOTAL VALUE $2410.45

OR

A complete VHF/UHF amateur radio station — including:

- The magnificent Yaesu FT726R VHF/UHF all mode transceiver
- 6 metre, 2 metre and 70cm modules to suit!
- Satellite unit giving full cross-banding facilities
- 100 metres RG-213 (UHF grade) co-ax cable

TOTAL VALUE $2384.50

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Don't forget that Dick Smith Electronics **guarantees** to match any genuine, advertised price on Yaesu equipment* — and we're extending this offer for the life of this competiton.

*Offer applies only where the advertiser has goods in stock AND can supply at the advertised price. Bait advertising is illegal under the Trade Practices Act.

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Check out these amazing special offers – now there's no excuse not to get that new Yaesu. You benefit three ways:

- **You save money!**
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- **And you could win $8000 worth!!!**

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Win! For your club. worth of prizes.

competition from Dick Smith Electronics amateur radio equipment!

fantastic prizes:

AND THAT'S NOT ALL!!!

We're also giving away a complete Yaesu FTR-5410 UHF (70cm) amateur repeater, complete with cavities, supply, power amp . . . the lot . . . to the club, group or body nominated by the winner!!!

Total retail value over $5000 . . . and just think:

IT COULD BE YOUR CLUB

S! that wins this fabulous prize generously donated by Yaesu Musen in the interests of promoting Amateur Radio in Australia!!!

HERE'S HOW EASY IT IS TO ENTER!!!

Every purchaser of ANY item of Yaesu Amateur Radio Equipment from Dick Smith Electronics stores or company authorised re-sellers during December 1984 and January & February 1985 will receive an entry form. Every purchaser.

All you have to do is, in the space provided on the entry form, tell us why your club/group/division/etc would like to win the UHF repeater.

It's as simple as that!

Here's your chance to win for yourself and your club – and all you have to do is buy your Yaesu from Dick Smith Electronics.

YAESU

Dick Smith Electronics and Yaesu are proud to sponsor this exciting competition, which has been organised to co-incide with the beginning of the 75th Anniversary Year of the Wireless Institute of Australia.

The WIA is the oldest such body in the world.

Congratulations, WIA, from Yaesu and Dick Smith Electronics.

YAESU FT-ONE

The best available. Normally $2495.00. Until Christmas save $200. Cat D-2852

NOW ONLY

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YAESU FT-980

A magnificent performer. Normally $1995.00 – Until Christmas save $250.00.

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Cat D-2920

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(All other Dick Smith stores carry some Yaesu products, but will be able to obtain others for you at short notice).

A869

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AR-2001

ONLY **$499**

+ $12 Reg. Post

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- Priority Channel
- Clock

SC-4000

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+ $10 Air Mail

FEATURES:

- ★ 160 Memory channels
- ★ 9 Band — Police, Government, Military, Landmobile, CB, Amateur, Radio Telephone, etc.
- ★ Over 45,000 Channels
- ★ Unique split programming system
- ★ Automatic frequency storage
- ★ Priority Channel
- ★ LCD Display
- ★ Programmable Scan/search rate
- ★ 24 Hour clock etc.

SPECIFICATIONS:

Freq. Range —
HF: 26-32 MHz
VHF: 66-88 MHz (low, 138-176 MHz (high)
UHF: 380-512 MHz
Sensitivity: 0.5 uV 66-176 MHz, 1uV380-512 MHz
Selectivity - 50dB + 25MHz
Scan/Search Date: 16 Ch per sec
Scan/Search Delay: Selectable 0.1 or 2 sec.
Memories: 160, 40 Ch x 4
Audio output: 0.5W RMS
Antenna: Flexible, 50 ohm with BNC Connector
Power Supply: 9VDC (UM3x6PCS) or NICAD
Dimensions: 175 (H) x 74 (W) x 37 (D) mm
Weight: 700 grms

UHF CB HERE AT LAST

FULLY SYNTHESISED UHF CB HAND-HELD TRANSCEIVER

EMTRON-ACE

Designed specially for AUSTRALIA

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APPLICATIONS:

- FARMING
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- CROWD CONTROL AND MANY OTHERS

FEATURES:

- 40 channel UHF CB
- Repeater offset CH.1 to CH. 10
- RF output, 2.5W high, 0.6W low
- Illuminated channel selection switch for night operation
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- Full range of accessories

SPECIFICATIONS:

GENERAL
Freq. range 476.425-477.400 MHz UHF CB
Freq. control: Digital PLL synthesiser
Type of emission: 16F3
Antenna Impedance 50 ohms
Power supply: 8.4 v ± 15%
Operating temperature: -10 to + 60°C

TRANSMITTER
Output power: High 2.5W, low: 0.5W at 8.4V
Modulation: Variable reactance FM
Max. Deviation: ±5 KHz
Spurious Emission: More than 70 dB below carrier
Microphone: Built in electret condenser mic.
Op Mode: Simp Dup Ch. 1-10, ch 11 to 40 auto simp

RECEIVER
Receiving System: Double Conversion Supethet
IF Frequency: 1st: 21.6MHz, 2nd: 455 kHz
Sensitivity: More than 26dB S + N at 1 uF. Less than 0.5uV for 20dB noise quieting.
Squelch Sensitivity: Less than 0.4uV
Spurious Response Rejection: More than 60dB
Selectivity: More than ±7.5 kHz at -60dB point, Less than + 15kHZ at -60dB point
AF Output: 400mW Audio Output Impedance: 8 ohms
Spurious Emission: More than -60dBm in 50 ohms

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BBC surveys receivers

Awareness of reception conditions means that broadcasters can better cater to the listener. Looking at listeners' receivers, the BBC gleaned facts about their equipment, reception and got a better picture of the shortwave listener worldwide.

The BBC World Service Audience Research Unit recently conducted a survey of the radio receivers used by listeners, and a sample of around 2000 listeners covering all continents revealed some interesting statistics. The members of the audience surveyed by the BBC were not ardent shortwave listeners, in fact 75% of them were listeners who simply tuned to the BBC London, and had no other interests in the shortwave hobby, or knowledge in the wider field of frequencies, propagation and other deterrents to good shortwave reception.

The variety of radio receivers throughout the world was indicated in the survey by over 670 different models which were basically manufactured by 130 companies. The receiver brands common in various parts of the world reflected the companies heavily promoting in those areas e.g: in Europe, Grundig, ITT, Philips and the like; in Japan and the South Pacific, Sony and other Japanese made receivers. In North America where Japanese made receivers are also popular, modern communication receivers were found in the homes of the shortwave listeners, however, on the other side of the receiver pattern, in the Middle East and India, it was obvious that many listeners are still using the old valve receivers and accomplishing much with the more vintage type equipment.

Quite illuminating to the BBC engineers was to find that 90% of sets in use, covered the 49 down to the 16 metre band, the main frequency range used by international broadcasters. The receiver design was also interesting, and of the modern radios, the calculator type receiver with its memories, digital readout and touch keyboard had made an impact. Not a great many of these receivers are being used at the moment by shortwave listeners, although there is an increasing awareness of the Sony ICF 2001 and other designers moving into that type of production.

Bush House, London: home of the BBC External Services from which a recent world wide survey was conducted to find the type of listening equipment used by the audience to the World Service.

Use of an outside aerial was favoured by only a third of those surveyed; BBC engineers were disappointed that such a low percentage of listeners was without adequate outdoor aerials, and therefore working under difficulties in getting the best from their equipment.

Nevertheless, Allan Cooper of the Research Unit said: "It was encouraging to find that keen as they are, these listeners were even keener to try and stay with us; if conditions got bad, if the frequency went down, if we were too close, most of them would try and find another channel. Very few actually turned off or tried to retune to another station." He found the survey a most interesting one as it was the first time that listeners had been asked about their receiving equipment, listening conditions, aerials or other means to try and improve reception of the BBC World Service. It is obvious that when listeners find reception difficult due to the vagaries of shortwave reception, they do not easily give up listening.

— Arthur Cushen

KILOHERTZ COMMENT

ALASKA: KNLS Anchor Point, Alaska which broadcasts gospel programmes in English, Chinese and Russian is operating to a new schedule up to March 2, 1985: 6170 kHz, 0700-1500 UTC; 7355 kHz, 1500-2000 UTC, then up to May 4 the schedule will be 6170 kHz, 0930-1500 UTC; 7355 kHz, 1500-2000 UTC; 9540 kHz, 0700-0930 UTC. English is broadcast 0700-0930 UTC and 1730-2000 UTC, Russian 0930-1200 UTC, 1500-1730 UTC, and Chinese 1200-1500 UTC. The out of band frequency of 7355 is being used for broadcasts over the North Pole. Permission has been granted by the FCC to use this frequency due to the congestion of the normal shortwave bands.

BOLIVIA: Radio San Jose is a new station operated in the Oruro province and is the official voice of the miners in that area. Broadcasts have been received on 5985 kHz from around 0930 UTC and at 1000 UTC a clock chimes six, and full identification in Spanish follows. This is followed by a siren which is repeated each half hour and is a typical time announcement (no doubt used by the population to report to work).

GREAT BRITAIN: The BBC World Service is now broadcasting news on the hour every hour. In the past there have been no news bulletins at 0100 UTC, 1000 UTC, 1400 UTC, 1900 UTC and 2100 UTC. Once a month when a 90 minute play is scheduled the news for that period will be cancelled.

Major frequency changes have taken place to improve our summer reception of the BBC and the additional channel of 21550 kHz is in use to Australia at 0900-1115 UTC. New Zealand and Australian listeners have additional coverage on 6175 kHz, 0430-0730 UTC, 7325 kHz, 1700-2030 UTC, 11820 kHz, 1800-2030 UTC and 15400 kHz, 1800-2030 UTC. Reception in the mornings in our area continues through Singapore on 9570 kHz, 2000-2245 UTC and 11965 kHz, 2000-2200 UTC. Evening reception 0545-0915 UTC continues on 7150 kHz, 9640 kHz and 11955 kHz, and after 0900 UTC, 9740 kHz and 11750 kHz provide the best signals.

NEPAL: Radio Nepal at Kathmandu is now using 7165 kHz for English, 1440-1540 UTC. News is broadcast at 1455 UTC and the frequency suffers from severe sideband interference, while the alternative channel of 5005 kHz is blocked up to 1500 UTC by Radio Sarawak but with fair reception after that time.

PAPUA NEW GUINEA: Several stations are projected to move from 120 metre band to 90 metre band and already Radio Manus in Lorengau is using 3315 kHz having moved from 2428 kHz. Signals are observed around 1030 UTC while test music has been noted at 1845 kHz prior to sign on at 1900 UTC when the new frequency is announced by Radio Manus which broadcasts from the Admiralty island.

This item was contributed by Arthur Cushen, 212 Earn St, Invercargill New Zealand, who would be pleased to supply additional information on medium and shortwave listening. All items quoted are UTC (GMT) 10 hours behind Sydney time, all frequencies are in kilohertz (kHz). In areas observing daylight time, add another hour.

OBITUARY

Practical Wireless Magazine has noted the death of Harold Cottam at the age of 93.

Mr Cottam was a Marconi Ships Wireless Operator, and was serving on the Cunard liner Carpethia during April 1912, when he heard radio messages coming from the ill-fated liner Titanic. By great good fortune, he had remained on duty after his normal watch, and heard the shore station at Cape Cod send a warning message to the Titanic regarding icebergs in the area. He attempted to relay the message, but received in return the doomed ship's distress messages.

Harold at once notified the captain of the Carpethia of the impending tragedy, and as a result the ship was the first to arrive at the scene of the tragedy. Carpethia rescued 771 people. There were 2201 passengers of the 'unsinkable' Titanic.

Danish pager

The RX808 pager from Niros is now available in Australia.

The unit provides voice reproduction by using a new transducer that is responsible for an audio level of 85 dBA at 300 mm. The RX808 provides for open channel monitoring using a conventional carrier squelch circuit. The same programming button will also provide for call memory.

It will operate in 68-88 MHz, 146-174 MHz and 406-520 MHz, providing a receiver sensitivity better than 0.7 μV for 20 dB Sinad (CEPT method). The pager's coding may be selected between CCIR, ZVEI or EIA, all five tone sequential.

For more information contact **Telmar Communications. (03)690-8666.**

Masco sells Bearcat

The Bearcat name has been transferred from Masco's subsidiary, Electra Company, to Uniden, along with the patents on Bearcat scanner radios and allied products.

Electra will continue to manufacture Bearcat products for Uniden for an unspecified period of time, though not every model in the Bearcat line will be continued. The financial details of this agreement were not made public.

Bosch radio

Robert Bosch (Australia) has launched a new range of Bosch hand-held portable radios.

Described as rugged, versatile, reliable and easy to use, the hand-held portable radios, HFG 84 and HFT 164 can be used on VHF low and high bands respectively. They have a slim line and are dust and splash proof. The frequency synthesiser provides 32 channels with options available for 64 channels. They are specifically designed for use in industrial applications.

Frequencies are programmed via a flexible EPROM. Transmitter power is internally adjustable between 0.1-1 W or 1-2.5 W. Five tone selective calling is available as an option and can be internally field programmed for either ZVEI or CCIR tone groups.

For further information contact **Weston Communications Group Pty Ltd, 31 Coventry Street, South Melbourne Vic 3205. (03)690-7233.**

WIN YOUR CLUB A UHF REPEATER . . . AND YOURSELF AN AMATEUR STATION!

In a new competition announced by Dick Smith Electronics who are the factory authorised importers and suppliers of Yaesu amateur radio equipment in Australia, the major prize-winner won't even be an entrant! The major prize winner will be a club, group or association nominated by the entrant — and that group will receive a magnificent new **Yaesu 70 cm amateur repeater** — complete and ready to 'plug in' to a power point and suitable antenna.

This much-sought-after prize, valued at almost $5000, has been donated by Yaesu Musen, Japan, to help promote amateur radio activity in Australia and the 430 MHz band in particular.

Entry to the competition is open to anyone — to qualify, all they have to do is purchase any item of Yaesu equipment from any Dick Smith Electronics store. Then they have to explain (in the space provided on the entry form) why their club/group/association etc should be awarded the prize.

The best answer will win the prize for the body nominated. It's as simple as that.

Judges will be representatives from Dick Smith Electronics and the Wireless Institute of Australia. While there is no restriction on the group to whom the prize is awarded, it is expected that the group will be, or is prepared to become, affiliated with the Wireless Institute of Australia to facilitate the issue of a repeater licence by the Dept of Communications.

By the way, the entrant is not forgotten either. For his or her efforts in winning a repeater for his club, he or she will be rewarded with a complete Yaesu amateur station — either HF (based on the Yaesu FT757GX) or VHF/UHF (based on the Yaesu FT726R). The individual prize is donated by Dick Smith Electronics.

Both of these stations are valued at well over $2000 — and in the case of the HF station, the prize even includes the antenna! Total value of prizes in this contest is around $8000. The contest officially starts December 1, and judging will take place (and the winners announced!) during March.

LISTENING TO LATIN AMERICA

Signals from Latin America on medium and shortwave present a challenge. The unpredictability of station replies and the fascination of listening to locally based Latin American programmes is a reward in itself.

Arthur Cushen

Trans World Radio, Bonaire — Transmitter building and towers of this popular gospel radio station.

SOUTH OF THE United States border is the area regarded as Latin America, covering Central and South America, and the Caribbean. Spanish is spoken in almost every country except Brazil, where the language is Portuguese, and the Caribbean where there are many local dialects including French and Creole. English is the major language of many of the former colonial British islands in the Caribbean, nevertheless, nearly all regional transmissions are in Spanish.

Tropical bands

The majority of locally based shortwave transmissions in South America is on the tropical band, generally in the 60 metre band 4750-5050 kHz. Some are heard in the 90 metre band, 3200-3400 kHz and a few use the 120m band, 2200-2500 kHz. Reception is in two phases — in our winter during the afternoons in Australia, stations can be heard signing off, and in the summer the stations are heard with sign on and morning programmes.

Most stations open with the national anthem and South Americans are heard at 0800 UTC from Brazil, 1000 UTC Venezuela and 1100 UTC from Colombia, Peru and Ecuador, but of course many open before this time. They may be agriculturally based, operated by a mining company or have religious affiliations, so that the morning opening times vary.

Opening identification generally includes the call sign, station slogan and details of frequencies on medium, shortwave and even FM transmissions. the city and country and also the time are generally part of the sign on announcement. The morning programmes include news, commercials and bright Latin music. Once one has been able ▶

Surinam is a country under a new government,and Radio Apintie a well known signal from South America.

to identify much of the spoken material, writing a detailed and accurate report becomes no difficulty.

The pattern of these tropical band stations follows a similar one to mediumwave signals, and once daylight occurs at the transmitting end, signals rapidly fade out. Listening to these stations in the Australian evening, one seldom hears the Brazilians after 1100 UTC or most South Americans after 1230 UTC while Central Americans can be audible to past 1300 UTC. Caribbean signals are heard around 0900 to past 1100 UTC.

English broadcasts

There is some external broadcasting from South America mainly from HCJB, (Quito, Ecuador), Trans World Radio and Radio Nederland (Bonaire), Radio Braz (Brazilia, Brazil), and RAE Radio Argentina Exterior from Buenos Aires, Argentina. All these stations have some English broadcasts which enable the first loggings of a station in South America to be relatively easy.

In Central America and the Caribbean, Voice of Nicaragua and Radio Havana, Cuba, are the strongest signals carrying English programmes, while the BBC and Deutsche Welle have relays on Antigua; and Voice of America has mediumwave facilities at the same location. There are numerous gospel stations in the Central American Caribbean area which broadcast occasional English programmes, but these could not be classed as being received on a regular basis.

Station verification

The excitement of hearing Latin American signals is often tinged with the knowledge that the percentage of replies is generally low. Listeners should be aware that IRCs (International Reply Coupons) obtainable at the Post Office to be used by the station for return postage are not always valid in Peru. Postage stamps are an attraction to mail handlers and commemorative stamps should not be used, as the possibility of the letter reaching the station is particularly reduced; in Ecuador, HCJB reports that some 30% of the mail never reaches its destination. Aerogrammes are the safest way to report reception and guard against the unscrupulous mail sorter or deliverer. The name of a station official should be used if possible, and can be found in the *World Radio and Television Handbook* which details the station personalities to which a report should be directed. Enclosures such as travel booklets, stickers and souvenirs often lead to verification, when the initial report remains unanswered, and this follow up is sent by surface mail. Because a listener verifies a station does not mean that he will automatically receive a confirmation of his report. Always quote the station's local time and date, spell out the day and month and do not use figures, as there are two systems of presenting this material which causes confusion. Make sure your letter has a return address so that failure to effect delivery will mean your report is returned. This writer has verified over 500 South American stations and has confirmed these in every South and Central American country on shortwave, as well as all Caribbean stations, with shortwave transmissions, but this total has taken 45 years to collect and many thousands of reports would have gone unanswered by stations over that period of listening. ●

A 'GLASS TELETYPE' USING THE VZ200

Part 2

Keeping up with the popularity of radioteletype transmission has prompted a few projects from us. Last month we published Part 1 of project 756, designed and developed by Dick Smith's R & D Department to add on an RTTY to the accessible VZ200. This article completes that project and should get you on the airwaves.

IN THE FIRST PART of this article we described the construction of the hardware for your VZ200 RTTY interface. Hopefully by now you have a working RTTY interface plugged into your computer and are rarin' to get on the airwaves and start decoding these dots and dashes. In this part we give the final hookup information and details on using the software as well as a full software listing. Start warming up those transceivers and read on . . .

Now comes the time to connect your transceiver to the interface. Connection is made through the five-pin DIN plug on the rear panel. Wire the TX output and PTT pins to a microphone plug, and the RX input to a speaker plug. You will probably prefer to fit an extension speaker so you can monitor the received signals. Plug the microphone and speaker plugs into your transceiver anbd adjust the receive volume for a comfortable listening level to start with. High receive volume with the mute open on FM, will cause random characters to appear on the screen. This is to be expected if you over-drive the preamp/filters. These high volume levels are not required, and normal operation will require the volume to be no more than normal listening level.

If operating on VHF/UHF, the RTTY signals will probably be FM. This makes things easy, as the received tones will be of the correct frequency. Simply select the channel and adjust the volume. The 'lock detect' LED will light when a signal is being received correctly.

When operating on HF using SSB, care is required in tuning to the correct frequency. The LED will indicate when you are close. If you can't resolve it, try the other sideband.

This RTTY interface is designed to use a shift of 170 Hz. If you wish to receive commercial TTY (many of which use larger shifts), simply tune into one tone only. The 'lock' effect of the XR2211 will ensure correct data reception. Again, if you have difficulty, try the other sideband, the other tone, or another baud rate. NOTE: When receiving commercial, wide-shift TTY, the LED will flash in time with the data, due to the out-of-lock condition on one tone.

The normal specifications for Amateur RTTY are as follows

Mark (logic low)	2125 Hz
Space (logic high)	2295 Hz
Shift	170 Hz
Speed	45.45 baud

Idle: logic high
1 start bit
5 data bits
1.5 stop bits

That concludes the general operation of the RTTY interface. Those Sydney operators who are new to RTTY will find plenty of activity on the Sydney RTTY repeater on 146.675 MHz. There is also a RTTY simplex channel on 146.600 MHz You will find many operators only too glad to encourage newcomers to this mode of communications.

GENERAL OPERATION

Entering your callsign.
On power-up, your VZ200 RTTY interface will introduce itself. To continue, press any key. You will then be asked to enter your callsign. You may enter anything up to 64 characters but it is recommended that if you wish to use the WRU mode, you use the following format:

enter your callsign
VK2FGH (PETER)

There should be no leading space before the callsign and there should be at least one space after the callsign. Apart from that, you may add anything you like up to 64 characters total. This enables your callsign to be used as the WRU code. You may wish to use another code instead. If so, it must not be longer than a normal callsign (i.e: six letters) although it may be shorter, and it must always be followed by a space character. If you press <RETURN> at this point instead of entering text, the callsign buffer will contain a null and any attempt to send a callsign will give no response. The disadvantage of this is that your WRU system (when activated), instead of being selective, will respond to any WRU sent.

Loading the programmable buffers.
Once you have entered your callsign, press <RETURN> and you will enter the buffer entry mode. In this mode, you are able to enter text into any of the six programmable buffers. Each buffer may contain up to 64 characters. You may start entering text by typing the number of the buffer you require. Your VZ200 will display the buffer number you have selected. Simply enter your text as you require.

Note: the SHIFT M command is used for the backspace key.

Press <RETURN> when you are finished, and your buffer is programmed. Repeat the process for each buffer you require to program, including the WRU buffer (buffer 0). When you have finished, press SHIFT X to enter the MENU.

Menu mode.
From the MENU you are able to enter the three main operation modes, i.e: receive mode, transmit mode, and buffer entry mode. You can return to the menu at any time from any of these modes by using SHIFT X.

Receive mode.
In this mode you are able to receive RTTY. The first thing you will notice is the command line at the top of the screen. This line tells you the current status of the system. In the RECEIVE mode it will display RECEIVE MODE on the left. On the right will be the number 45. This is the current BAUD rate. The system will always default to 45.45 baud.

The command line is also used to display the current status of the PRINTER and WRU modes. These modes always default to the OFF status.

To demonstrate this, hold down the ▶

PROGRAM LISTING

```
ADDR   0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F

4000: AA 55 E7 18 21 FF 7F F9 F3 3E 0D 21 09 80 77 11
4010: 0A 80 01 80 01 ED B0 3E EC 32 08 80 AF 32 06 80
4020: 32 07 80 CD EF 49 CD D9 49 CD C9 01 21 F7 43 CD
4030: A7 28 CD 20 47 FE 00 28 F9 CD C9 01 21 AC 44 CD
4040: A7 28 21 8F 81 C3 2E 46 CD DA 41 CD C9 01 AF 32
4050: 00 60 21 F6 81 22 F4 81 77 11 F7 81 01 01 04 ED
4060: B0 CD CA 46 32 F2 81 21 60 42 CD A3 45 21 90 42
4070: CD A7 28 21 D6 42 CD A7 28 21 09 43 CD A7 28 CD
4080: F4 2E FE 31 CA 93 40 FE 32 CA 1F 48 FE 33 CA B5
4090: 45 18 EC AF 32 00 60 CD C9 01 21 1E 42 CD A3 45
40A0: CD 77 46 CD D9 49 CD EF 49 21 C0 71 22 00 80 21
40B0: E0 70 22 F0 81 CD 70 4B AF 32 05 80 CD 23 49 3A
40C0: 05 80 FE FF CA 28 48 CD 8F 46 1E 00 3A 00 50 CB
40D0: 7F 28 E9 CD 23 49 3A 05 80 FE FF CA 28 48 CD 8F
40E0: 46 3A 00 50 CB 7F 20 EB 0E 08 CD 1E 45 CD 18 45
40F0: 3A 00 50 CB 17 CB 11 38 05 CD 18 45 18 F2 CD 18
4100: 45 21 E0 46 06 00 16 00 79 FE 1B 20 02 1E 01 FE
4110: 1F 20 02 1E 00 CB 21 19 09 7E FE 09 FA 2E 41 FE
4120: 0D 20 02 1E 00 CD 68 45 CD 30 41 CD 5B 41 18 A3
4130: E5 D5 F5 3A 07 80 FE 00 28 1D 37 3F ED 5B F8 85
4140: 21 38 86 ED 52 28 10 F1 FE 0C 38 08 2A F8 85 77
4150: 23 22 F8 85 D1 E1 C9 F1 D1 E1 C9 F5 D5 F5 3A 06
4160: 80 FE 00 20 03 F1 18 2F 21 D0 81 11 DA 81 01 0A
4170: 00 ED B0 21 DA 81 11 D1 81 01 09 00 ED B0 11 D0
4180: 81 F1 12 21 E4 81 11 D9 81 1A BE 20 0A 23 1B 7E
4190: FE AA 28 06 1A 18 F3 D1 F1 C9 D1 F1 21 0C 42 ED
41A0: 5B F4 81 01 06 00 ED B0 ED 53 F4 81 3E 06 32 F2
41B0: 81 CD F6 41 3E 0D CD 30 41 3A 00 50 CB 7F 20 F9
41C0: 0E 32 CD 1E 45 CD 18 45 3A 00 50 CB 7F 20 EA 0D
41D0: 20 F3 3A 05 80 2F 32 05 80 C9 21 8F 81 11 E4 81
41E0: 7E 12 FE 20 23 13 28 02 18 F6 06 04 21 FC 44 7E
41F0: 12 23 13 10 FA C9 06 0C 21 7F 00 C5 01 64 00 CD
4200: 5C 34 01 00 20 CD 60 00 C1 10 ED C9 95 0D 0D 90
4210: 0D 23 57 52 55 00 20 20 20 00 50 52 54 00 52 45
4220: 43 45 49 56 45 20 4D 4F 44 45 20 20 20 20 20 20
4230: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 00 54
4240: 52 41 4E 53 4D 49 54 20 4D 4F 44 45 20 20 20 20
4250: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 00
4260: 20 20 20 20 20 20 20 20 20 56 5A 2D 32 30 30 20
4270: 20 52 54 54 59 20 20 20 20 20 20 20 20 20 00 00
4280: 34 35 20 00 35 30 20 00 37 35 20 00 31 31 30 00
4290: 0D 0D 0D 20 20 20 20 20 20 20 20 20 20 20 20 20
42A0: 4D 45 4E 55 0D 0D 20 20 20 31 29 20 52 45 43 45
42B0: 49 56 45 20 20 20 32 29 20 54 52 41 4E 53 4D 49
42C0: 54 0D 20 20 20 33 29 20 4C 4F 41 44 20 42 55 46
42D0: 46 45 52 53 0D 00 0D 20 20 50 52 45 53 53 20 D3
42E0: C8 C9 C6 D4 20 D8 20 41 54 20 41 4E 59 20 54 49
42F0: 4D 45 0D 20 20 20 20 20 20 20 20 20 20 46 4F
4300: 52 20 4D 45 4E 55 0D 0D 00 0D 20 20 20 20 20 20
4310: 20 20 20 53 45 4C 45 43 54 20 28 31 2D 33 29 0D
4320: 00 0D 0D 20 20 20 20 20 20 42 55 46 46 45 52 20
4330: 49 4E 50 55 54 20 52 4F 55 54 49 4E 45 0D 0D 0D
4340: 0D 0D 20 20 45 4E 54 45 52 20 42 55 46 46 45 52
4350: 20 4E 55 4D 42 45 52 20 28 30 2D 35 29 00 20 57
4360: 52 55 20 42 55 46 46 45 52 0D 00 20 42 55 46 46
4370: 45 52 20 23 31 0D 00 20 42 55 46 46 45 52 20 23
4380: 32 0D 00 20 42 55 46 46 45 52 20 23 33 0D 00 20
4390: 42 55 46 46 45 52 20 23 34 0D 00 20 42 55 46 46
43A0: 45 52 20 23 35 0D 00 44 45 20 0D 43 51 20 43 51
43B0: 20 43 51 20 43 51 20 43 51 20 43 51 20 43 51 20
43C0: 43 51 20 43 51 20 43 51 20 0D 20 50 4C 53 20 4B
43D0: 4B 20 4B 4B 20 4B 4B 0D 52 59 52 59 52 59 52 59
43E0: 52 59 52 59 52 59 52 59 52 59 52 59 52 59 52 59
43F0: 52 59 52 59 52 59 0D 0D 0D 20 20 20 20 20 20 20
4400: 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A
4410: 2A 2A 0D 20 20 20 20 20 20 20 2A 20 20 56 5A 2D
4420: 32 30 30 20 20 52 54 54 59 20 20 2A 0D 20 20 20
4430: 20 20 20 20 2A 20 54 45 52 4D 49 4E 41 4C 20 20
4440: 50 41 43 4B 20 2A 0D 20 20 20 20 20 20 20 2A 2A
4450: 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A
4460: 0D 0D 20 20 20 20 20 20 20 20 20 20 20 20 20 20
4470: 46 52 4F 4D 0D 20 20 20 20 20 44 49 43 4B 20 53
4480: 4D 49 54 48 20 45 4C 45 43 54 52 4F 4E 49 43 53
4490: 0D 20 20 20 20 20 20 20 43 4F 50 59 52 49 47 48
44A0: 54 20 28 43 29 20 31 39 38 34 0D 00 0D 45 4E 54
44B0: 45 52 20 59 4F 55 52 20 43 41 4C 4C 53 49 47 4E
44C0: 20 3A 0D 00 54 48 45 20 51 55 49 43 4B 20 42 52
44D0: 4F 57 4E 20 46 4F 58 20 4A 55 4D 50 53 20 4F 56
44E0: 45 52 20 54 48 45 20 4C 41 5A 59 20 44 4F 47 20
44F0: 30 31 32 33 34 35 36 37 38 39 20 0D 57 52 55 AA
4500: 53 54 41 54 49 4F 4E 20 49 44 45 4E 54 49 46 49
4510: 43 41 54 49 4F 4E 20 0D CD 1E 45 CD 23 49 C5 3A
4520: 08 80 06 0B 10 FE 3D 20 F9 C1 C9 2A 00 80 FE 0D
4530: 28 05 FE 20 30 23 C9 ED 5B 20 78 D5 22 20 78 3E

4540: 0D 21 02 80 BE 28 06 CD 3A 03 32 02 80 2A 20 78
4550: 22 00 80 D1 ED 53 20 78 C9 FE 40 38 02 D6 40 77
4560: 32 02 80 23 22 00 80 C9 E5 D5 C5 F5 CD 2B 45 7C
4570: FE 71 28 02 18 06 7D FE E0 D4 81 45 F1 C1 D1 E1
4580: C9 F5 21 40 71 11 20 71 01 A0 00 ED B0 21 C0 71
4590: 3E 20 77 11 C1 71 01 20 00 ED B0 21 C0 71 22 00
45A0: 80 F1 C9 11 00 70 7E FE 00 C8 FE 40 30 02 C6 40
45B0: 12 23 13 18 F1 CD C9 01 21 21 43 CD A7 28 21 D6
45C0: 42 CD A7 28 CD 63 4B CD 20 47 CD 79 4B FE 01 CA
45D0: 48 40 FE 30 28 16 FE 31 28 1D FE 32 28 24 FE 33
45E0: 28 2B FE 34 28 32 FE 35 28 39 18 DB 21 5E 43 CD
45F0: A7 28 21 09 80 18 37 21 6B 43 CD A7 28 21 4A 80
4600: 18 2C 21 77 43 CD A7 28 21 8B 80 18 21 21 83 43
4610: CD A7 28 21 CC 80 18 16 21 8F 43 CD A7 28 21 0D
4620: 81 18 0B 21 9B 43 CD A7 28 21 4E 81 18 00 06 40
4630: CD 70 4B E5 C5 CD 20 47 C1 FE 01 28 36 FE 00 28
4640: F3 FE 08 E1 28 12 77 FE 0D CA B5 45 23 CD 3A 03
4650: CD 70 4B 10 DE C3 B5 45 78 FE 40 28 D1 3E 08 CD
4660: 3A 03 3E 20 CD 3A 03 3E 08 CD 3A 03 04 2B CD 70
4670: 4B 18 C0 E1 C3 48 40 3A 08 80 FE EC CA 65 4C FE
4680: D7 CA 47 4C FE 8D CA 51 4C FE 61 CA 5B 4C C9 F5
4690: C5 E5 D5 CD C4 05 CB 47 20 18 3A FA 85 FE 00 28
46A0: 11 CD DB 46 FE 0D 20 07 3E 0A 32 FA 85 18 E4 CD
46B0: B7 46 D1 E1 C1 F1 C9 11 FA 85 21 FB 85 01 40 00
46C0: ED B0 2A F8 85 2B 22 F8 85 C9 AF 21 FA 85 22 F8
46D0: 85 77 11 FB 85 01 40 00 ED B0 C9 D3 0E D3 0D C9
46E0: 05 05 54 35 0D 0D 4F 39 20 20 48 00 4E 2C 4D 2E
46F0: 00 00 4C 29 52 34 47 24 49 38 50 30 43 3A 56 3D
4700: 45 33 5A 2B 44 00 42 3F 53 27 59 36 46 25 58 2F
4710: 41 2D 57 32 4A 27 04 04 55 37 51 31 4B 28 07 07
4720: 21 FE 68 0E 08 06 06 7E F6 04 1F 30 4F 10 FB CB
4730: 05 0D 20 F1 06 04 21 DF 68 7E CB 57 28 23 CB 05
4740: 7E CB 57 28 20 CB 05 7E CB 57 28 1D CB 05 CB 05
4750: CB 05 7E CB 57 28 16 3E FF 32 04 80 AF 32 03 80
4760: C9 0E 03 18 17 0E 02 18 13 0E 01 18 0F 3A 03 80
4770: CB CF 32 03 80 3E FF 32 04 80 AF C9 21 B0 47 1E
4780: 00 3A 03 80 CB 4F 28 02 1E 30 3E 08 91 4F 3E 06
4790: 90 47 CD A3 47 83 06 00 4F 09 7E 21 04 80 BE 28
47A0: D9 77 C9 AF B9 28 07 C6 06 0D 28 02 18 F9 80 C9
47B0: 54 57 20 45 51 52 47 53 20 44 41 46 42 58 20 43
47C0: 5A 56 35 32 20 33 31 34 4E 2E 20 2C 20 4D 36 39
47D0: 2D 38 30 37 59 4F 0D 49 50 55 48 4C 3A 4B 3B 4A
47E0: 75 72 00 73 71 74 85 87 00 84 89 8F 83 01 00 81
47F0: 0A 00 25 22 20 23 21 24 00 00 00 00 00 08 26 29
4800: 3D 28 90 27 00 82 91 95 88 94 86 3F 00 2F 2B 00
4810: 21 20 71 3E 20 77 11 21 71 01 C0 00 ED B0 C9 CD
4820: C9 01 21 E0 70 22 F0 81 CD 10 48 3E FF 32 05 80
4830: AF 32 EF 81 21 3F 42 CD A3 45 CD 77 46 CD D9 49
4840: CD EF 49 21 C0 71 22 00 80 CD 70 4B 3E FF 32 00
4850: 60 06 96 CD 18 45 10 FB CD 23 49 3A 05 80 FE 00
4860: CC C6 48 CD 8F 46 CD 10 4A FE 00 28 EB FE 71 CA
4870: CD 4B FE 72 CA D7 4B FE 73 CA E1 4B FE 74 CA EB
4880: 4B FE 75 CA F5 4B FE 81 CA 84 4B FE 82 CA 9B 4B
4890: FE 84 CA 94 4B FE 88 CA A5 4B FE 89 CA AF 4B FE
48A0: 8F CA B9 4B FE 90 CA C3 4B FE 95 CA 8D 4B FE 23
48B0: CA CE 48 CD 30 41 CD D4 48 CD 68 45 FE 0D CA 3E
48C0: 4B CD B7 4A 18 92 21 F6 81 7E FE 00 C0 F1 CD 63
48D0: 4B C3 93 40 F5 F5 FE 0D 28 1A FE 20 28 0E 3A EF
48E0: 81 FE 3E 28 0F 3C 32 EF 81 F1 F1 C9 3A EF 81 FE
48F0: 39 DA E5 48 AF 32 EF 81 F1 FE 0D 28 ED FE 20 28
4900: 08 3E 2D CD 68 45 CD B7 4A CD 5E 4B CD 59 4B 3E
4910: 0D CD 68 45 F1 FE 20 28 08 F5 3E 01 32 EF 81 F1
4920: C9 AF C9 D5 C5 CD 20 47 FE 00 28 66 FE 01 28 68
4930: FE 0A CA B7 49 FE 87 CA 9E 49 FE 83 28 66 FE 86
4940: CA CD 49 FE 94 CA C1 49 FE 85 28 5D FE 91 28 5F
4950: CD 3F 4A F5 E5 C5 FE 08 20 16 2A F2 81 7C B5 CA
4960: 03 4A 2B 22 F2 81 2A F4 81 2B AF 77 3E 08 18 1C
4970: F5 ED 4B F2 81 21 FC 03 ED 42 7C B5 CA 0D 4A 2A
4980: F2 81 23 22 F2 81 F1 2A F4 81 77 23 22 F4 81 C1
4990: E1 F1 C1 D1 CD 70 4A C9 C1 D1 F1 C3 48 40 CD 17
49A0: 4C C1 D1 C9 CD CA 46 18 F8 C1 D1 F1 C3 39 40 3E
49B0: 0D 2A F8 85 77 18 EA C1 D1 3A 05 80 2F 32 05 80
49C0: C9 3A 06 80 2F 32 06 80 CD D9 49 18 D4 3A 07 80
49D0: 2F 32 07 80 CD EF 49 18 C8 3A 06 80 FE 00 20 05
49E0: 21 16 42 18 03 21 12 42 11 10 70 CD A6 45 C9 3A
49F0: 07 80 FE 00 20 05 21 16 42 18 03 21 1A 42 11 15
4A00: 70 18 E8 C1 E1 F1 C1 D1 AF CD 70 4A C9 F1 18 F3
4A10: 2A F2 81 7C B5 C8 2B 22 F2 81 21 F6 81 7E FE 00
4A20: C8 F5 21 F7 81 01 00 04 09 AF 77 21 F7 81 11 F6
4A30: 81 01 00 04 ED B0 2A F4 81 2B 22 F4 81 F1 C9 E5
4A40: C5 D5 F5 2A F0 81 7D FE 3F D2 6B 4A 21 60 70 11
4A50: 40 70 01 A0 00 ED B0 21 E0 70 3E 20 77 11 E1 70
4A60: 01 20 00 ED B0 21 E0 70 22 F0 81 F1 D1 C1 E1 C9
4A70: FE 08 28 25 FE 0D 28 05 FE 20 30 28 C9 ED 5B 20
```

```
4A80:  78 D5 2A F0  81 22 20 78  3E 0D CD 3A  03 2A 20 78
4A90:  22 F0 81 D1  ED 53 20 78  C9 2A F0 81  3E 20 2B 77
4AA0:  22 F0 81 C9  FE 40 38 06  FE 60 30 02  D6 40 2A F0
4AB0:  81 77 23 22  F0 81 C9 D6  0A FE 03 CA  5E 4B D6 13
4AC0:  FE 40 D0 FE  03 CA D8 4A  FE 21 D2 D8  4A 08 FE FF
4AD0:  28 10 3E FF  08 C3 33 4B  08 FE 00 28  05 AF 08 C3
4AE0:  28 4B 08 CD  E7 4A C9 21  76 4C 01 00  00 4F 09 4E
4AF0:  06 06 CB 11  CB 11 CB 11  DA 07 4B C3  12 4B 10 F6
4B00:  CD 1C 4B CD  8F 46 C9 3E  FF 32 00 58  CD 18 45 C3
4B10:  FE 4A AF 32  00 58 CD 18  45 C3 FE 4A  3E FF 32 00
4B20:  58 CD 18 45  CD 1E 45 C9  F5 0E 1F CD  F0 4A F1 CD
4B30:  E7 4A C9 F5  0E 1B CD F0  4A F1 CD E7  4A C9 0E 02
4B40:  CD F0 4A C3  46 4B 0E 08  CD F0 4A C3  58 48 0E 04
4B50:  CD F0 4A 08  AF 08 C3 58  48 0E 08 C3  F0 4A 0E 02
4B60:  C3 F0 4A 01  FF BF CD 60  00 01 FF BF  CD 60 00 C9
4B70:  C5 01 FF 5F  CD 60 00 C1  C9 F5 C5 01  FF 2F CD 60
4B80:  00 C1 F1 C9  FD 21 AB 43  CD FF 4B 18  07 FD 21 00
4B90:  45 CD FF 4B  FD 21 A7 43  CD FF 4B FD  21 8F 81 CD
4BA0:  FF 4B C3 58  48 FD 21 CA  43 CD FF 4B  C3 58 48 FD
4BB0:  21 D8 43 CD  FF 4B C3 58  48 FD 21 C4  44 CD FF 4B
4BC0:  C3 58 48 FD  21 09 80 CD  FF 4B C3 58  48 FD 21 4A
4BD0:  80 CD FF 4B  C3 58 48 FD  21 8B 80 CD  FF 4B C3 58
4BE0:  48 FD 21 CC  80 CD FF 4B  C3 58 48 FD  21 0D 81 CD
4BF0:  FF 4B C3 58  48 FD 21 4E  81 CD FF 4B  C3 58 48 FD
4C00:  7E 00 FE 0D  C8 F5 CD 68  45 CD 30 41  CD 8F 46 CD
4C10:  B7 4A F1 FD  23 18 E8 3A  08 80 FE EC  28 0D FE D7
4C20:  28 10 FE 8D  28 13 FE 61  28 16 C9 3E  D7 32 08 80
4C30:  18 15 3E 8D  32 08 80 18  18 3E 61 32  08 80 18 1B
4C40:  3E EC 32 08  80 18 1E 11  1B 70 21 84  42 CD A6 45
4C50:  C9 11 1B 70  21 88 42 CD  A6 45 C9 11  1B 70 21 8C
4C60:  42 CD A6 45  C9 11 1B 70  21 80 42 CD  A6 45 C9 01
4C70:  FF FF CD 60  00 C9 08 02  00 04 00 00  00 0B 16 00
4C80:  1A 1E 09 00  11 06 18 07  17 0D 1D 19  10 0A 01 15
4C90:  1C 0C 03 0E  00 00 0F 00  13 00 18 13  0E 12 10 16
4CA0:  0B 05 0C 1A  1E 09 07 06  03 0D 1D 0A  14 01 1C 0F
4CB0:  19 17 15 11  FF 04 FF 04  FF 4C FF 4C  FF 4C FF 4C
4CC0:  FB 48 FB 48  FB 48 FB 08  FB 08 FB 00  FB 00 FB 00
4CD0:  FB 48 FB 08  FB 08 FB 08  FB 00 FB 00  FB 00 FB 00
4CE0:  FB 48 FB 48  FB 48 FB 08  FB 00 FB 00  FB 00 FB 00
4CF0:  FB 48 FB 08  FB 08 FB 08  FB 00 FB 00  FB 00 FB 00
4D00:  37 00 FF 04  FF 04 FF 04  FF 0C FF 0C  FF 0C FF 0C
4D10:  FF 04 FF 04  FF 04 FF 04  FF 0C FF 0C  FF 0C FF 0C
4D20:  FF 04 FF 04  FF 04 FF 04  FF 0C FF 0C  FF 0C FF 0C
4D30:  FF 04 FF 04  FF 04 FF 04  FF 0C FF 0C  FF 0C FF 0C
4D40:  FB 08 FB 08  FB 08 FB 08  FB 00 FB 00  FB 00 FB 00
4D50:  FB 08 FB 08  FB 08 FB 08  FB 00 FB 00  FB 00 FB 00
4D60:  FB 08 FB 08  FB 08 FB 08  FB 00 FB 00  FB 00 FB 00
4D70:  FB 08 FB 08  FB 08 FB 00  FB 00 FB 00  FB 00 FB 00
4D80:  37 0C FF 0C  FF 0C FF 0C  FF 4C FF 0C  FF 4C FF 0C
4D90:  FF 0C FF 04  FF 04 FF 04  FF 4C FF 4C  FF 4C FF 0C
4DA0:  FF 0C FF 0C  FF 0C FF 0C  FF 4C FF 0C  FF 4C FF 0C
4DB0:  FF 0C FF 04  FF 0C FF 04  FF 4C FF 0C  FF 4C FF 4C
4DC0:  FB 48 FB 08  FB 48 FB 08  FB 08 FB 08  FB 08 FB 08
4DD0:  FB 08 FB 08  FB 08 FB 08  FB 08 FB 08  FB 08 FB 08
4DE0:  FB 48 FB 08  FB 48 FB 08  FB 08 FB 08  FB 08 FB 08
4DF0:  FB 08 FB 08  FB 08 FB 08  FB 08 FB 08  FB 08 FB 08
4E00:  37 0C FF 0C  FF 0C FF 04  FF 0C FF 0C  FF 04 FF 04
4E10:  FF 04 FF 04  FF 04 FF 04  FF 0C FF 0C  FF 0C FF 04
4E20:  FF 0C FF 04  FF 0C FF 0C  FF 0C FF 04  FF 0C FF 04
4E30:  FF 04 FF 04  FF 04 FF 04  FF 0C FF 04  FF 0C FF 0C
4E40:  FB 08 FB 08  FB 08 FB 00  FB 08 FB 08  FB 08 FB 08
4E50:  FB 08 FB 00  FB 08 FB 00  FB 08 FB 08  FB 08 FB 08
4E60:  FB 08 FB 08  FB 08 FB 00  FB 08 FB 08  FB 08 FB 08
4E70:  FB 08 FB 08  FB 00 FB 00  FB 08 FB 08  FB 08 FB 08
4E80:  17 0C FF 0C  FF 04 FF 04  FF 0C FF 04  FF 04 FF 04
4E90:  FF 04 FF 04  FF 04 FF 04  FF 04 FF 04  FF 04 FF 04
4EA0:  FF 04 FF 04  FF 04 FF 04  FF 04 FF 04  FF 04 FF 04
4EB0:  FF 04 FF 04  FF 04 FF 04  FF 04 FF 04  FF 04 FF 04
4EC0:  FB 08 FB 00  FB 00 FB 00  FB 08 FB 08  FB 08 FB 08
4ED0:  FB 08 FB 00  FB 00 FB 00  FB 08 FB 08  FB 08 FB 00
4EE0:  FB 00 FB 00  FB 00 FB 00  FB 08 FB 08  FB 08 FB 08
4EF0:  FB 00 FB 00  FB 00 FB 00  FB 08 FB 00  FB 00 FB 08
4F00:  37 04 FF 04  FF 04 FF 04  FF 04 FF 04  FF 04 FF 04
4F10:  FF 04 FF 04  FF 04 FF 04  FF 04 FF 04  FF 04 FF 04
4F20:  FF 04 FF 04  FF 04 FF 04  FF 04 FF 04  FF 04 FF 04
4F30:  FF 04 FF 04  FF 04 FF 04  FF 04 FF 04  FF 04 FF 04
4F40:  FB 00 FB 00  FB 00 FB 00  FB 00 FB 00  FB 00 FB 00
4F50:  FB 00 FB 00  FB 00 FB 00  FB 00 FB 00  FB 00 FB 00
4F60:  FB 00 FB 00  FB 00 FB 00  FB 00 FB 00  FB 00 FB 00
4F70:  FB 00 FB 00  FB 00 FB 00  FB 00 FB 00  FB 00 FB 00
4F80:  37 0C FF 0C  FF 0C FF 04  FF 0C FF 04  FF 04 FF 04
4F90:  FF 04 FF 04  FF 04 FF 04  FF 04 FF 04  FF 04 FF 04
4FA0:  FF 0C FF 04  FF 04 FF 04  FF 04 FF 04  FF 04 FF 04
4FB0:  52 4F 4D 20  43 4F 4E 54  45 4E 54 53  20 43 4F 50
4FC0:  59 52 49 47  48 54 20 28  43 29 20 31  39 38 34 20
4FD0:  44 49 43 4B  20 53 4D 49  54 48 20 45  4C 45 43 54
4FE0:  52 4F 4E 49  43 53 20 50  54 59 2E 20  4C 54 44 2E
4FF0:  20 41 55 53  54 52 41 4C  49 41 2E 00  00 00 00 00
```

NOTES & ERRATA

Nov '84, project 756, p 106: On page 107, last column, note that there are **nine** links on the decoder board, not eight. On the circuit diagram, page 109, C23 should read 470n; the Parts List is correct. On page 110, in the table under "Immediate Commands", the second command is SHIFT X. In the text on page 110, second last paragraph, the last sentence should read: "See that the two polarised capacitors (C21 and C22) are correctly oriented." Note that R7 is actually 2k7, as per the Parts List, not 4k7, as per the circuit.

THE SOFTWARE

There is an unused section in the VZ200 memory map between 4000H and 67FFH. This area was set aside for use with plug-in software packs. The RTTY unit fits into this area of memory.

For design simplicity, this section is decoded into five 2K blocks. The first two blocks are used for the main software routines. The other three blocks are used for receive data, transmit data and relay data.

All data transfer is done through bit 7 (D7). The software also uses a section of RAM starting at 8000H. This area is used to store volatile data such as buffers and flags.

Some useful RAM and EPROM addresses are given below.

RAM LOCATIONS

8000/01	Receive character cursor position
8005	Receive/transmit toggle flag
8006	WRU flag
8007	Printer flag
8008	Timing loop value (231 = 45.45 baud)
8009	Start of buffer 0
804A	Start of buffer 1
808B	Start of buffer 2
80CC	Start of buffer 3
810D	Start of buffer 4
814E	Start of buffer 5
818F	Start of callsign storage area
81F0/F1	Transmit cursor position
81F6	Start of keyboard input buffer

EPROM LOCATIONS

4000	EPROM entry point
4039	Callsign entry routine
45B5	Buffer entry routine
4048	Menu entry point
4093	Receive routine entry point
468F	Line printer routine entry point
4518	Delay routine
4923	Keyboard input and video processing routine
4810	Transmit entry point
484C	Transmit active point
4568	Transmit data video display routine
4AB7	ASCII to baud conversion
49B7	Toggle receive/transmit relay on/off
49C1	Toggle WRU on/off
49CD	Toggle printer on/off
499E	Change baud rate 45-50-75-110-45 etc.

OTHERS

5000	Receive data
5800	Transmit data
6000	Transmit/receive relay

MODIFICATIONS TO VZ/RTTY DECODER TO IMPROVE PERFORMANCE ON WIDEBAND COMMERCIAL RTTY

The following changes to component values will allow less critical receiver tuning when decoding wideband commercial RTTY found on the HF bands.

While values are given for both 425 Hz and 850 Hz shifts, prototype units constructed for 850 Hz shift use were quite capable of resolving stations using 425 Hz shifts.

It should be noted that once these modifications have been performed, it is highly unlikely that the decoder will resovle 170 Hz shift amateur RTTY.

CHANGES FOR 850 Hz SHIFT (1450/2300 Hz)

I) Changes to filter stages

Change:

R35	from	300k 5%	to	180k 5%
R34	from	27k 5%	to	27k 1%
R33	from	3k9 1%	to	27k 1%
R32	from	680k 1%	to	1M 1%
R31	from	680k 1%	to	18k 5%
R19	from	390k 5%	to	100k 5%
R18	from	220k 5%	to	470k 5%
R17	from	3k9 1%	to	8k2 1%
R16	from	1M 1%	to	47k 5%

R15 no change.

II) Changes to FSK decoder

Change:

RV2	from	10k	to	20k
R14	from	18k 1%	to	15k 1%
R12	from	270k 5%	to	47k 5%
R11	from	470k 5%	to	1M5 5%
C7	from	330n	to	39n

CHANGES FOR 425Hz SHIFT (1875/2300Hz)

I) Changes to filter stages

Change:

R35	from	330k 5%	to	220k 5%
R34	from	27k 5%	to	39k 1%
R33	from	3k9 1%	to	12k 1%
R32	from	680k 1%	to	820k 1%
R31	from	680k 1%	to	68k 1%
R19	from	390k 5%	to	150k 5%
R18	from	220k 5%	to	47k 5%
R17	from	3k9 1%	to	8k2 1%
R16	from	1M 1%	to	100k 1%

R15 no change

II) Changes to FSK decoder

Change:

RV2	from	10k	to	20k
R14	from	18k 1%	to	12k 1%
R12	from	270k 5%	to	100k 5%
R11	from	470k 5%	to	1M5 5%
C7	from	330n	to	39n

SHIFT key and press U. The command line will display WRU. This indicates that the WRU mode is now active. Again press SHIFT U, and the WRU will no longer be displayed, indicating the WRU mode is disabled. Try the same with SHIFT H. This enables and disables the printer. Similarly, SHIFT 5 changes the BAUD rate.

The screen is split into two sections, each with independent scrolling. All received text is displayed on the bottom screen, while the top screen is used to display your typed text. You may type and receive simultaneously. The type ahead buffer can contain up to 1024 (1K) characters. Any data from the buffers may be added as you go by pressing the appropriate enable keys. A graphic block will be displayed as you type to show you that a buffer has been enabled. You may terminate your text with the '#' code. When this code is found during transmission, your system will automatically revert to the receive mode.

Transmit mode.

When the station you are communicating with has finished his transmission, you may reply to him by pressing

SHIFT Z

This sends your terminal to the transmit mode, enabling your transmitter, and sending the test you previously typed. You may continue typing if you wish. Your system will continue to send the stored text, including any programmed text, until it catches up with your typing, whereby it will follow the text as you type it. During all this time, the text is displayed on the bottom screen, along with the contents of any programmed buffers you may have enabled. Thus you can see everything being sent in its final form. You may exit to receive by using either

#
or
SHIFT Z

Note: SHIFT Z will not work if there is still data in the buffer waiting to be sent. This prevents you from accidentally terminating the transmission prematurely. If you wish to abort your transmission intentionally, use

SHIFT X

to get back to the menu.

WRU mode.

The WRU mode is a special feature included to add versatility to your system. To activate this mode, press

SHIFT U

The letters WRU will appear on the command line. When this mode is active, any station sending your callsign (or any other code entered on power-up), followed by the letters WRU, will activate your system. When this happens, your VZ200 will first Beep to let you know that your system is being called. After checking to ensure the frequency is clear, your transmitter will then activate automatically, sending 'STATION IDENTIFICATION DE < callsign>', along with any message stored in the WRU buffer (buffer # 0).

For example, if you had entered on power-up 'VK2FGH (PETER)' any station wishing to activate your WRU mode would need to send

VK2FGH WRU

Your system would then respond with

STATION IDENTIFICATION DE
VK2FGH (PETER)

If you had programmed the WRU buffer, your system might also add

PLEASE STAND BY . . .
++ OPERATOR ALERTED ++

or something similar.

If you wished to leave a special message your could put any code up to six letters long (followed by a space, of course) in the callsign storage buffer, and the special message in the WRU buffer. Only the stations aware of your code will be able to access the message.

Inbuilt pre-programmed buffers.

There are seven pre-programmed messages stored in your VZ200 terminal. Many of these are designed to insert your callsign automatically when called, to save you time and effort. These buffers and their enable commands are listed below:

Note: one row of text here is 32 characters. Thus it will only fill one half of a normal 64 character screen.

SHIFT C: Send — CQ
One row of CQs is sent along with your callsign

SHIFT A: Send — RYs
One row of RYs is sent.

SHIFT F: Send — QBF
Send 'THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG 0123456789'

SHIFT P: Send — over terminator.
The message 'PLEASE KK KK KK' is sent to terminate your call.

SHIFT I: Identify your station.
The message 'STATION IDENTIFICATION DE (callsign)' is sent. This is the same as is sent by the WRU mode.

SHIFT O: Send — Callsign.
Your callsign (as entered on power-up) is sent.

SHIFT D: Send — DE callsign.
As above except 'DE' is added to the start of your callsign.

Following are the commands to send the programmable buffers.

SHIFT Q: Send buffer #1

SHIFT W: Send buffer #2

SHIFT E: Send buffer #3

SHIFT R: Send buffer #4

SHIFT T: Send buffer #5

SHIFT 0: Send WRU buffer (buffer #0)

At any time you may require to restart the system. This is useful if you wish to re-enter your callsign, or enter your own WRU code. To do this, type

SHIFT G

This exits the current mode and restarts at the callsign entry mode. You may now re-enter your callsign.

Printer Function.
Your VZ200 will also drive a line printer. You may enable or disable the printer mode using

SHIFT H

Once enabled, all text received or transmitted will be sent to the printer to be stored as 'hard copy'. Note: If you enable the printer but do not have a printer on-line, your system will not be affected and will ignore the enable mode. *But*, text will still be stored in the internal printer buffer until the buffer finally fills up.

The internal print buffer is only 64 characters long and is designed to hold characters only when the printer is busy printing. Because of this, any text received when the printer is not on-line but the print routine is enabled, will be truncated in the buffer. If you have the print mode enabled and don't want to print the text which has been stored in the internal print buffer, you may clear the buffer with the following command

SHIFT B

There will be times when a station does not terminate his contact with a CARRIAGE RETURN (CR). When this happens, you may find the last line of text does not get printed on the line printer. This is because many printers wait for a CR before printing the next line of text. By using the command

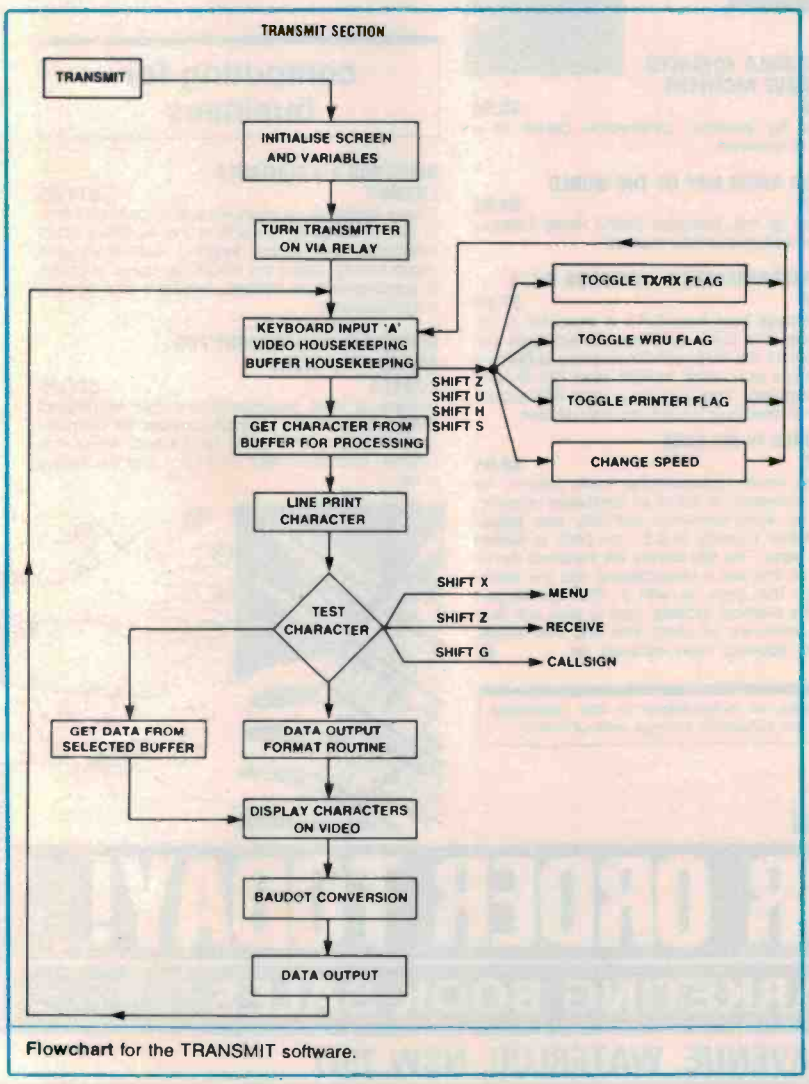
SHIFT <RETURN>

a carriage return will be inserted into the print buffer, thereby forcing it to print the last line. This can be done at any time to clear the printer's buffer, by forcing it to dump its contents onto paper.

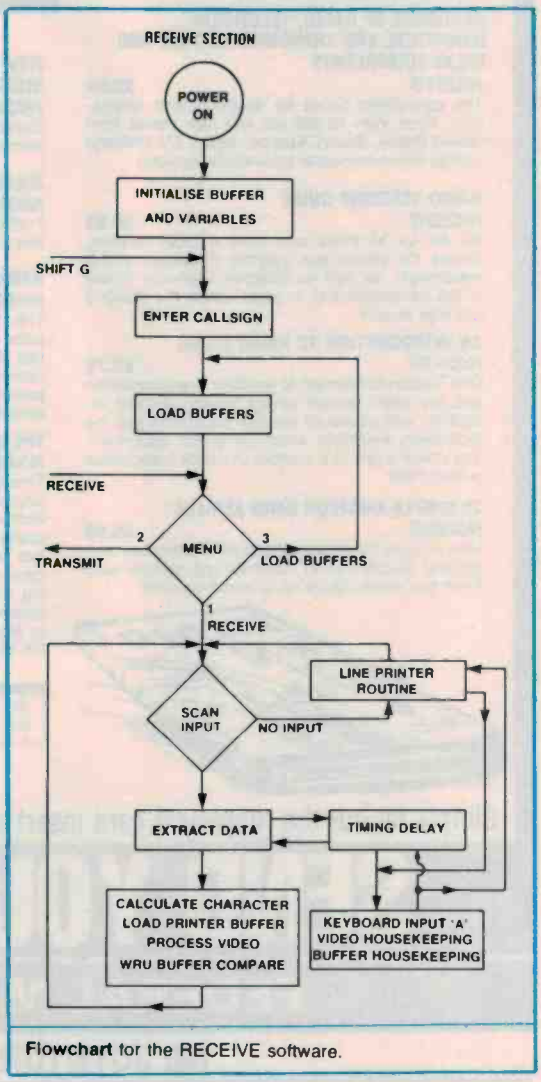
That concludes the main operation description. The rest will come with experience, as will normal RTTY operating procedures.

For further information on amateur RTTY, we suggest you contact *The Australian National Amateur Radio Teleprinter Society* at the following address:

The Secretary,
ANARTS,
PO Box 860,
Crows Nest NSW 2065



Flowchart for the TRANSMIT software.



Flowchart for the RECEIVE software.

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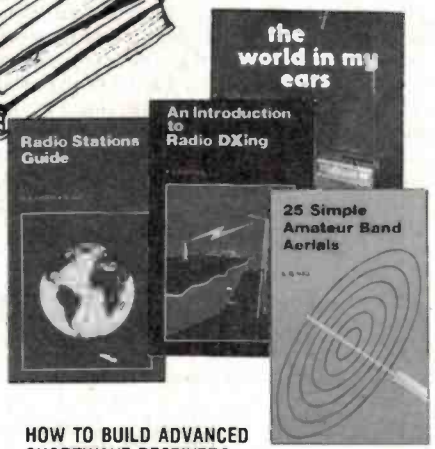

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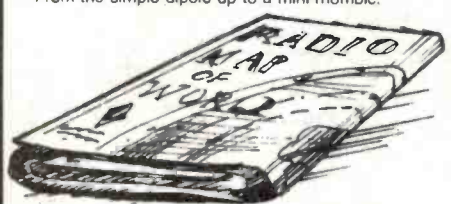

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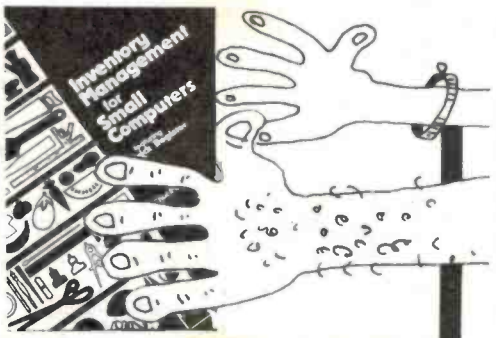

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The ETI-755 RTTY transceiver described last month was designed to be easily interfaced to various small computers. In this article we'll hook it up to the Microbee to provide a complete radioteletype sending and receiving system.

RADIO-TELETYPE TRANSCEIVER

Part 2

Tom Moffat

WHAT WE ARE DOING is not new. Electronic RTTY systems have been around for some years, first as stand-alone hardware devices, and later as add-ons for popular home computers. A most desirable feature seems to be a split-screen facility, in which you can prepare messages to be transmitted on one part of the video screen while material is still being received on another part.

The Microbee system has been designed around the split-screen idea. Figure 1 is a 'screen-dump' picture showing how it looks during an actual two-way contact. The part of the screen above the dotted line displays the copy received from the distant station. Below the line is your station's outgoing copy. It is important to realise that the two screens are completely independent of each other. Each scrolls up when it feels the need; each has its own pointer (which you can't see) to tell it where the next character goes. The only thing they share is a piece of glass.

Many of the commercial RTTY suppliers seem to pride themselves on the complexity of their systems. One even boasts "over 40 commands". The Microbee system takes the opposite approach, following the 'KISS' principle (Keep It Simple, Stupid). It's designed to allow the operator to concentrate on operating rather than trying to remember which command does what.

Atlhough 'mice' and 'icons' seem to be the 'in' things nowadays, the Microbee doesn't provide such luxuries. So we use the 'control key' method of issuing commands. You hold down the control key with one hand and then point at the keyboard with the other. When you find the command you want you simply jab at it, and the result appears on the transmit screen section in inverse video. The characters are not transmitted (except for <RETURN>, <LINE FEED>, and <BELL>). None of the inverse characters causes a character to be printed at the receiving end (unless the receiving end is using TAPE mode, as described below).

The program is designed to emulate the workings of a mechanical teletype system consisting of a sending/receiving teleprinter, a high speed tape punch, and a paper tape reader. The functions of these machines are all there, but the hassles aren't. No noise, no paper tape strewn all over the place, no maintenance problems.

In its simplest form the program can be used as a teleprinter only, forgetting the paper tape punch and reader. In this case you can type back and forth with the other station by hitting <CONTROL S> to send, and <CONTROL C> or BREAK to receive. The software and the RTTY transceiver turn your transmitter on and off for you. (From now on we will refer to the control key as '^'.) The distant station's text is displayed on the upper screen, and your copy is on the lower. As you get more adventurous you can invoke some of the other functions.

The functions

Now let's look at the program's functions one by one:

^S = SEND

TRANSMIT COMMANDS

^S	Send from keyboard.
^A	Autosend (send contents of transmit buffer).
^R	Repeat (send first line of transmit buffer repeatedly).
^I	Copy 'IDENT' message into transmit buffer and send.
^B	Copy 'BRAG' message into transmit buffer and send.
^W	Store transmit buffer contents as 'BRAG' message.
^DEL	Erase complete transmit buffer/screen.
^C (or BREAK RESET)	Exit transmit mode to receive incoming copy. Stop sending and clear screens.

RECEIVE COMMANDS

^T	Display received copy in 'tape' mode.
^F	Force figures/letters change (toggle action).
^P	Enable/disable printer (toggle action).

'^' means control key.

This command turns on your transmitter, sends eight 'letters shift' characters, sends carriage return and line feed (CRLF), and then waits for you to start typing. Each character is sent as you type it, unless you are a bloody fast typist. In this case it is possible for you to outrun the transmitter, which is limited to 60 words a minute or so. If this happens you will notice a little square cursor marching along somewhere behind you, marking each character on the screen as it is transmitted.

If you really steam it along, you'll reach the stage where the cursor might be a few lines behind (don't scroll the cursor off the screen, or you'll lose the whole line being transmitted, leaving you with the last character sent sitting on the dotted line as a souvenir. If you're a fair way ahead you can sit back and rest as the cursor catches up.

The effect, as seen by the receiving station, is of a punched paper tape being sent through a tape transmitter at 'machine speed', the fastest speed possible at the baud rate you're using. Your keyboard is the tape punch, and when you get ahead you're simply piling up a loop of unsent tape, before it gets pulled through the reader.

^A = AUTOSEND

This mode will make a lousy typist look good to the person on the other end, at least for a while. Here you can prepare your outgoing text in advance on the lower screen, while still receiving from the other station on the upper screen. Any mistakes you make can be fixed up with BACK SPACE. When your turn comes to send, you hit ^A. The program sends eight LTRS then CRLF, and then the little cursor starts sending your copy from the beginning of the lower screen.

As it's stepping along at machine speed you can be adding further text at the end of what's already there. Eventually though, the cursor will catch up with you (unless you're a speed demon), and you'll be back to sending at your 'hunt and peck' speed. If you're clever you'll turn it over to the other station just before this happens, and your crummy typing will remain a secret.

^R = REPEATING

This mode repeats the first line of the transmit screen over and overandoverandover. This is your test message generator or automatic 'CQ' caller. You can set it up with such things as "THE QUICK BROWN FOX JUMPED OVER THE LAZY DOG" (very traditional) or "RYRYRYRYRYRYRYRY" or "TOM MOFFAT IS A SEX SYMBOL". If the line is terminated by <RETURN> a CRLF will be sent at the end of each line. If the <RETURN> is omitted at the end of a few RYs the system will produce a continuous string of 'reversals', a standard teletype test signal.

You can get out of the repeating mode by hitting ^A, ^S, ^C, or RESET. If you select AUTOSEND (^A) just as the cursor comes to the end of the first line, the program will send the first line once more and then continue on through the rest of the transmit screen. So you can set up the first line to send "CQ CQ CQ DE VK7TM VK7TM VK7TM" and the second line to say something like "CALLING FROM HOBART, TASMANIA . . . PSE KKK". If you start with ^R the CQs will repeat several times; you then hit ^A to finish your CQ call in style.

^I = IDENTIFY

This command will cause the station identification to be entered at your current location on the transmit screen. You can see how the command has been used in the two way contact shown in Figure 1. The data comes from the 32 byte long memory area 'IDENT' which you must program as part of the initial setting up procedure for the system. This will be described in detail shortly.

^B = BRAG TAPE

When you issue this command your entire transmit screen will be wiped and replaced with the contents of a 512 byte memory area 'BRGST'. The transmit cursor will then send the entire screen. This is an electronic version of the traditional 'brag tape' that every RTTY amateur has available to send at the drop of a hat. The brag tape usually raves on about what a brilliant system the amateur is using. Sending a brag tape normally triggers the transmission of a similar message from the other station, so watch out!

As the brag tape is being sent you can add even more waffle at the end, scrolling already sent material off the top. (Remember not to scroll off the line containing the transmit cursor.)

^W = WRITE BRAG TAPE

During the moment when you're not 'on air' you can write up a description of your station, inflating the facts as required. Once complete, you press ^W and the whole lower screen is copied to the memory area BRGST, from where it can be recovered by ^B as above. If you now re-record the RTTYTX program to cassette your brag tape will be recorded with it. It will be automatically loaded next time you load the program into the computer.

^DEL = ERASE WHOLE TRANSMIT SCREEN

Notice that two keys, CTRL and DEL, are required for this command, to prevent any embarrassing accidents. There's nothing worse than composing a whole screen full of gripping text, only to have it send to oblivion by the slip of a finger. You'll find you use this command before you start writing your material for each new 'over', or before you write a new brag tape.

^C (BREAK) = RECEIVE

This command sends CRLF, then eight LTRS, and then switches the RTTY transceiver into the receive mode, turning off the station transmitter in the process. When the system is finished transmitting some item such as your brag tape, at machine speed it reverts to the SEND mode so you can add further comments. The only way to get back into the receive mode is via the RECEIVE command, or by using RESET. The system of course initialises in the receive mode. ▶

```
IN VK7M VK7TM DE "TERRY" VK4AAT VK4AAT  FB TOM AND OK WILL TELL
THE BOYS UP HERE IN THE S.E.Q.T.G.
ABOUT THE COMING PROJECT..SOUNDS GOOD...YES ITS QUITE WARM
HERE TODAY. MY SHACK IS LOCATED IN THE BACK OF MY GARAGE
AND ALTHOUGH ITS LINES ETS ETC IT GETS QUITE WAROV..THJ THE
TEMP AT THE MOMENT IS 26C 26C... WELL TOM THANKS FOR THAT
I GET MOST OF OUR NEWS FROM VK3 VK2TTY AND A LITTLE LOCAL
CONTENT SO ALWAYS LOOKING FORR SOMETHING DIFFERENT..
I BROADCAST THE NEWS ON 40M AND ALSO ON OUR GROUPS REPEATER
VK4RBT ON MONDAY EVOUNGP AT UPPZ ON 70ET KHZ, BUT AT THE
MOVENT AS I N THE ONLY ONE I DONT THJ CALL BVIMVIVVMWOVMWQP1OMVM
PK ON I HOPE TO GET SOME ELSE TO TAKE
THE 2M CALL BACKS AND I WILL TAKE THE 40M....
SO THATS ABOUT IT HI HI BTU TOM
VK7TM VK7TM DE "TERRY" VK4AAT VK4AAT  PSE KKKK

-------------------------------------------------------------

VK4AAT DE VK7TM, FERN TREE, TASMANIA ... OK TERRY GOT MOST OF
THAT EXCEPT THAT SOMEBODY DROPPED A WHACKING BIG CARRIER ON TOP
OF YOU JUST BEFORE YOU TURNED IT OVER. CERTAINLY FEEL FREE TO
USE THE INFO ON THE NEW RTTY PROJECT ON YOUR BROADCAST... BUT
WHAT TIME AND FREQUENCY IS IT ON? I MAY HAVE A LISTEN TO MAKE
SURE I HAVEN'T BEEN LIBELED OR SOMETHING... HI...
VK4AAT DE VK7TM PSE KKK
```

Figure 1. Screen dump of an actual contact showing the received text on the upper part of the screen (above the line) and the text ready to send below the line.

```
E 051616 - U S  IMPERIALISM IS MASTERMIND AND WIREPULLER
          OF KWANGJU MASSACRE

   PYONGYANG MAY 16 (KCNA) -- THE SOUTH KOREAN PEOPLE ARE
LOOKING BACK ON THE KWANGJU BLOODBATH FOUR YEARS AGO
WITH RESENTMENT AND TOWERING NATIONAL INDIGNATION AT THE
U S  IMPERIALIST AGGRESSORS
    THE BACKSTAGE MANIPULATOR OF THE KWANGJU MASSACRE
WAS U S  IMPERIALISM WHICH HAS BEEN OCCUPYING SOUTH KOREA
FOR NEARLY 40 YEARS  TRANSFERRING A HUGE ARMED FORCE
AND EQUIPMENT TO TRAITOR CHON DU HWAN. IT ENCOURAGED HIM
TO CRACK DOWN WITH THE BAYONET UPON THE KWANGJU
CITIZENS RESISTING THE MAY 17 FASCIST ACTION
    THE U S  IMPERIALISTS EVEN HELD A "NATIONAL  SECURITY
CONFERENCE" TO ISSUE AN ORDER TO REPRESS THE KWANGJU
UPRISING WITH THE BAYONET AND OFFERED LEAD BULLETS
```

Figure 2. Korean Central News Agency transmission (KCNA) with the project operated in the normal 'page' mode. Note, this is a screen dump.

```
E 051616 - U.S. IMPERIALISM IS MASTERMIND AND WIREPULLER
          OF KWANGJU MASSACRE.

   PYONGYANG MAY 16 (KCNA) -- THE SOUTH KOREAN PEOPLE ARE
LOOKING BACK ON THE KWANGJU BLOODBATH FOUR YEARS AGO
WITH RESENTMENT AND TOWERING NATIONAL INDIGNATION AT THE
U.S. IMPERIALIST AGGRESSORS.
    THE BACKSTAGE MANIPULATOR OF THE KWANGJU MASSACRE
WAS U.S. IMPERIALISM WHICH HAS BEEN OCCUPYING SOUTH KOREA
FOR NEARLY 40 YEARS. TRANSFERRING A HUGE ARMED FORCE
AND EQUIPMENT TO TRAITOR CHON DU HWAN, IT ENCOURAGED HIM
TO CRACK DOWN WITH THE BAYONET UPON THE KWANGJU
CITIZENS RESISTING THE MAY 17 FASCIST ACTION.
    THE U.S. IMPERIALISTS EVEN HELD A "NATIONAL  SECURITY
CONFERENCE" TO ISSUE AN ORDER TO REPRESS THE KWANGJU
UPRISING WITH THE BAYONET AND OFFERED LEAD BULLETS
```

Figure 4. KCNA transmission as it would appear on a dot matrix printout straight off your Microbee.

```
S MASTERMIND AND WIREPULLER          OF KWANGJU MASSACRE
   PYONGYANG MAY 16 (KCNA) -- THE SOUTH KOREAN PEOPLE
 ARE  OOKING BACK ON THE KWANGJU BLOODBATH FOUR YEARS AGO
WITH RESENTMENT AND TOWERING NATIONAL INDIGNATION AT THE
S  IMPERIALIST AGGRESSORS     THE BACKSTAGE MANIPULATOR O
F THE KWANGJU MASSACRE  WAS U S  IMPERIALISM WHICH HAS BEE
N OCCUPYING SOUTH KOREA  FOR NEARLY 40 YEARS  TRANSFERRING
 A HUGE ARMED FORCE  AND EQUIPMENT TO TRAITOR CHON DU HWAN,
IT ENCOURAGED HIM  TO CRACK DOWN WITH THE BAYONET UPON THE KWA
NGJU  CITIZENS RESISTING THE MAY 17 FASCIST ACTION
THE U S  IMPERIALISTS EVEN HELD A "NATIONAL  SECU
RITY  CONFERENCE" TO ISSUE AN ORDER TO REPRESS THE KWANGJU
 PRISING WITH THE BAYONET AND OFFERED LEAD BULLETS
```

Figure 3. KCNA transmission received in the 'tape' mode, showing the letters shift, 'bell' codes, etc. (Also a screen dump, as per Figure 2).

```
>G E220
     4  D
  14F0  20 6C 69 6D  69 74 65 64  20 74 6F 20  36 30 20 77
  1500  6F 72 64 73  20 61 20 6D  69 6E 44 45  20 56 4B 37
  1510  58 59 5A 20  43 4F 4F 4C  41 4E 47 41  54 54 41 20
  1520  51 55 45 45  4E 53 4C 41  4E 44 00 6C  6C 20 6E 6F
  1530  74 69 63 65  20 61 20 6C  69 74 74 6C  65 20 73 71
  1540  75 61 72 65  20 63 75 72  73 6F 72 20  6D 61 72 63
```

Figure 5. Customising the station ident — this should appear on your screen at the start of the procedure.

RESET

This is the 'all stop' command, the *panic button*. The program reruns from scratch, turning the transmitter off and re-initialising everything. You will be left with the dividing line on the screen and nothing else. However your brag tape and station identification data will still be intact. The only more sure fire shutdown method is to pull out the mains plug.

Some further commands apply to the receiving side of the system. These are 'toggle' commands; the toggle commands are invoked when you press the key, and cancelled when you press the same key again. These commands will produce inverse characters on the transmit screen as confirmation that they have been issued. The characters will be ignored by the transmit cursor.

∧T = TAPE MODE

This mode simulates a paper tape printer, as opposed to a page printer. The received copy is printed continuously on the screen, with carriage returns and line feeds occuring only when each line is full. Words are split apart with gay abandon! This mode also shows the 'non-print' control characters as they are received, in inverse video. These are carriage return, line feed, figures and letters shift, blank, and bell.

Figure 2 shows a screen printout of a transmission from the Korean Central News Agency, in the normal 'page' mode. This was made at the start of a transmitting session, after the station had been sending RYs for a while.

Figure 3 shows the same thing, only in 'tape' mode. Notice the top line . . . letters shifts, used as a leader on the punched tape, followed by alternating letters and figures shifts for some reason, and then a few 'bells' to wake up the operator on the receiving end. After that the text begins, with carriage returns, line feeds, and figures and letters shifts sprinkled throughout.

Tape mode may not be pretty to look at, but it makes a handy diagnostic aid, and it makes copy easier under very rough conditions when the normal carriage returns and line feeds may be mangled.

∧F = FORCE

If you are receiving in figures case, ∧F will force it to letters. If you are in letters, ∧F will force the case to figures. Useful if a transmission error accidentally changes the case or causes you to miss a shift character . . . you can change it yourself.

∧P = PRINTER

Enables or disables the system output to a 1200 baud serial printer. Everything goes to the printer, both transmit and receive copy. The KCNA transmission discussed above is shown in Figure 4 as it appears on a normal dot matrix printer. The serial printer option is the only one available. The parallel port already has an RTTY transceiver plugged into it.

Customising the program for your station

The program, as published, has in its identification store "DE VK7XYZ COOLANGATTA QUEENSLAND". You must change this to your own call sign and location. The existing message is exactly 32 characters long, the maximum allowed in the IDENT store. It's a 'rubbish' callsign, purposely incorrect, so don't let it go to air. You must do some editing to effect the change; the system was planned this way to prevent any keyboard accidents during on-air operation from messing up your station ID.

First, under BASIC, load the 'virgin' program from your cassette. Hit ∧I and the above message should appear after the inverse video 'I'. Next, cold-start the computer using ESC and RESET. Now enter your system monitor mode, using 'M' and RESET as per the Microbee's instructions. If you don't have Wordbee or EDASM, and consequently no monitor, you should be doing this on someone else's 'Bee.

With the monitor fired up, give the command "E 150A" and the display shown in Figure 5 should appear on the screen. (Ignore the "G E220"; that called the screen dump routine.) You will see the cursor pointing at 44, and "D" shown at the top of the display. Now step the cursor along with ∧S, and the "D" will show the ASCII meaning of each byte; D-E- -V-K-7-X-Y-Z etc. After "QUEENSLAND" you will encounter the byte "00", two lines below where you started. This tells the computer the end of the ident has been reached. The last byte MUST be "00".

Now get your trusty Microbee user's manual and turn to the "ASCII-HEXADECIMAL-DECIMAL TABLE" in the appendix. Make up your own little table for

your own ident, using the HEX values, as follows:

D	44
E	45
(SPC)	20
V	56
K	4B
7	37
T	54
M	4D
(SPC)	20
H	48
O	4F
B	42

. . . and so on until your station ident is complete. Next, get the monitor cursor back to 150A, issue the 'M' for modify command and start typing in the bytes from your table: 44 45 20 56 etc. They'll replace the bytes that are already there. If you're using fewer than 32 characters, fill the rest of the store with 00s, until you reach the byte at 152A, where you stop. You can now record your customised version of the program back onto another cassette.

Making it all work

Now's the time to plug all the stuff together . . . and pray. First your receiver (or receivers): the best way to tap in is via a 'recording' connection, or through your own connection to the 'high' side of the volume control. This eliminates the receiver's audio circuits from the system. Some are quite distorted, and performance is generally better if the receiver's audio is avoided. In a pinch you can tap off the speaker terminals.

Transmit audio should have been organised as part of last month's construction article. If you put it off, do it now. But leave the transmitter keying circuit disabled for the time being.

Now connect the RTTY transceiver to your computer's parallel port and fire it up. With some audio (probably noise) coming from the receiver, the tuning indicators should be jumping around and the framing error LED may be flashing on and off.

Next, load your new customised tape under BASIC; it should autostart, showing the dotted line and possibly printing random characters on the upper screen. Now operate ^I and YOUR station ident should appear on the lower screen, with the little square cursor sending it out at machine speed. Hitting BREAK should restore the system to receive. Now try ^B (BRAG TAPE). If you are using a purchased tape, an interesting message should appear on the lower screen, with the cursor sending it out as before. Note that the message isn't really going anywhere as you have disconnected the transmitter keying line (I hope . . .).

Hit BREAK again, and then ^DEL which should clear the screen. Now try some typing, using the SEND and AUTO-SEND modes as described earlier. You'll soon get the hang of it. Make sure you can control the transmit functions with confidence before you use the system on air.

Now let's receive some teletype. It's best to try for one of the professional broadcasters before trying to capture a weaker and harder-to-tune amateur signal. A good one to look for is Australia's weather station AXM. It transmits RTTY during the first half of the hour on 11 030 kHz, as well as some other frequencies. The copy consists mostly of groups of five numbers. More interesting copy is available from the KCNA station shown in Figures 2, 3 and 4. It's about the strongest and easiest to copy 'press' service at the moment, transmitting on 13 780 kHz and 15 633 kHz.

When you find a station (listen for the "deedle-deedle" sound), tune your receiver so that the MARK indicator is jumping up with the higher audio tone. Now vary the shift control so the SPACE indicator is in step with the lower tone. The two indicators should now be jumping in opposition to each other. (Hint: AXM's tones are 850 Hz apart, KNCA's are 440 Hz apart. They both send at 50 bauds.) This procedure may seem a bit messy at first but you'll soon get used to it.

For amateur signals, start with the shift set for 170 Hz, as this is what most amateur stations use. If you have the input filter option, switch it on for narrow shift; it will make a remarkable difference in a crowded amateur band.

If the framing error LED is flashing when you tune a signal, switch your receiver to the other sideband, or operate the mark-high/mark-low switch. Framing errors are signalled when the UART finds an expected stop pulse is missing and calls a foul. This is usually the result of upside-down signals, the wrong baud rate, some code other than Baudot, or the occasional transmission error. You will not get printable copy while the framing error LED is flashing.

As you can see there are lots of variables when tuning RTTY signals. You may get frustrated at first, and swear up and down that the system doesn't work. Well, the program listing is a photograph of the actual listing of the working program as generated by the computer. There are no mistakes.

I'll always remember a letter I got about the ETI-733 project. "It's common knowledge all over Sydney that the project does not work," it said. The inference was that a whole magazine project had been developed and published to produce a device that didn't work. Please be assured that the 733 project does work, if you read the instructions. You can also be assured that this new RTTY project does work, if you read the you-know-whats.

Many receiving problems are the result of noise from the Microbee getting into the receiver. The Microbee doesn't have the shielding that some of the imported models have, and it's a very noisy computer. This is of little consequence in Australia, except when a sensitive HF receiver is sitting right next to it. There are a couple of measures that can mihimise the noise.

Try to get some physical distance between the receiver and the computer. Also, make sure you're using a *good* outside aerial, to get as much desired signal into the receiver as possible. This will reduce its gain (via the AGC), and with it, the influence of the Microbee. Most amateur radio installations have quite good aerial systems, and in my own case I can only hear computer noise when the bands are really dead. That's a good time to give up, anyhow, and wait for things to improve.

Using the '755 with other computers

Although the RTTY transceiver was designed with the Microbee in mind, it should work well with certain other computers. The Microbee program as it stands would be useless, of course, and anything for another computer would have to be written from scratch (and I ain't a-goin' to do it, so there!).

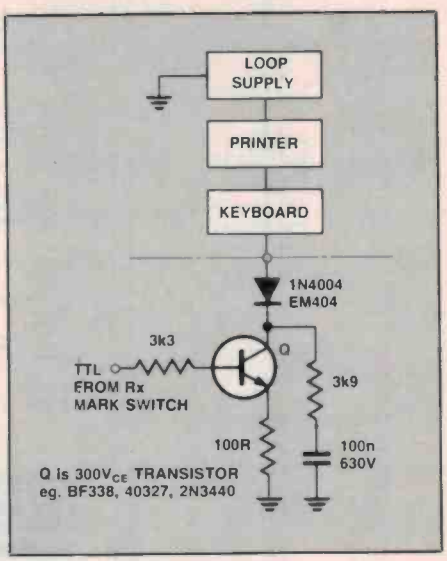
Certain allowances have been made, however, to make the '755 interface as universal as possible. Proper handshake lines haven't been used at all, as certain computers require signals different from others. The '755 should work with any computer using an input/output chip that can be programmed so some data bits are inputs while others are outputs. In other words it must make use of a 'data direction register' or DDR.

Fortunately, many of the popular cheaper computers have this facility. They include the VIC-20's VIA (Versatile Interface Adaptor) and the Commodore 64's CIA (Complex Interface Adaptor).

Other chips to look for in a likely computer are the Z-80 Parallel Input-Output, or PIO, (as in the Microbee) and the 6821 Peripheral Interface Adaptor (PIA) as used in many 6800, 6809, and 6502-based machines.

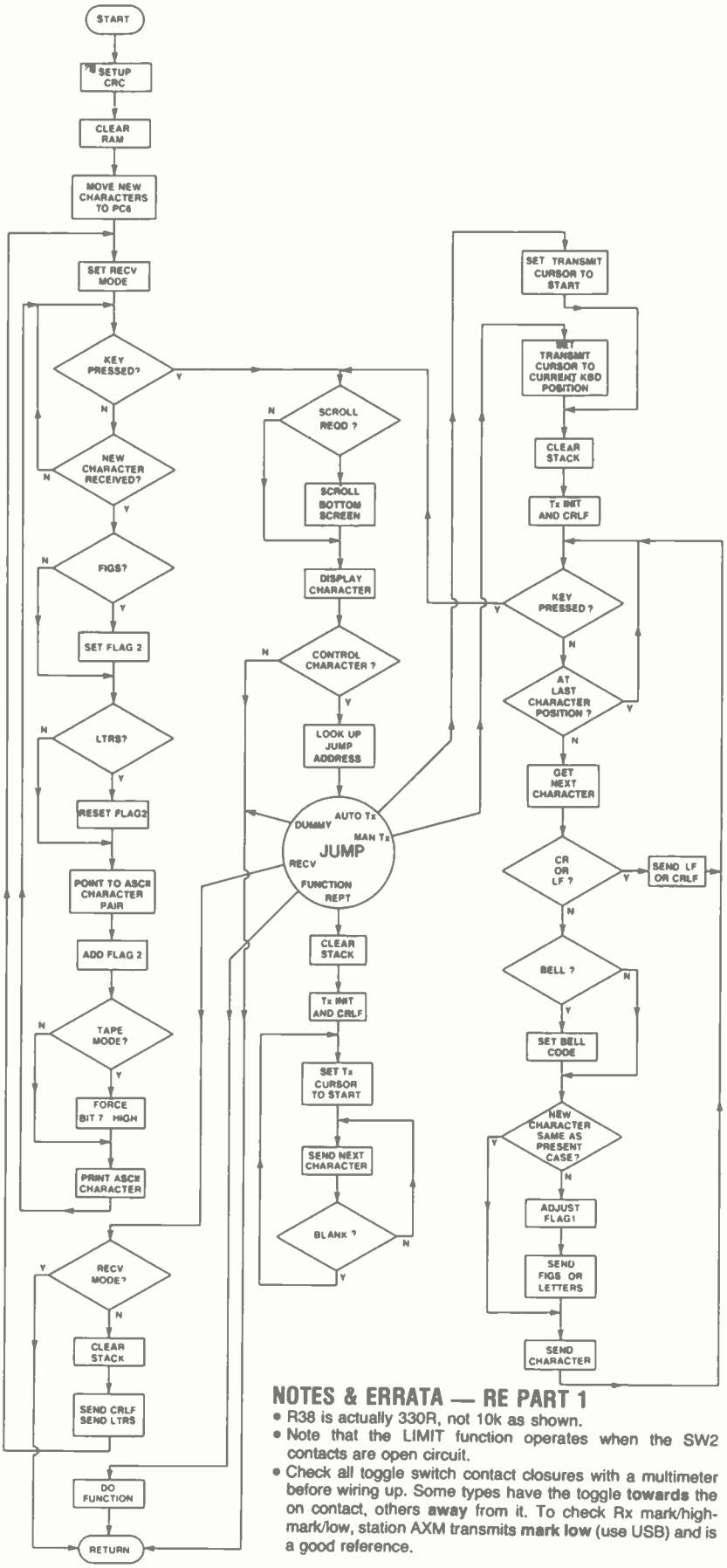
If you've ever had to deal with some of these chips you probably have your own names for them that can't be printed here!

Surprisingly, many of the more expensive computers don't have on-board input/output chips . . . you are expected to shell out for some kind of 'expansion interface' if you want one to hook up anything non-standard. So be warned. ▶



Teletype current loop interface. This circuit drives a mechanical teletype machine. Connect the input to the moving contact of SW3, the RX mark high/low switch. The ground connection should be made on the power supply board.

An attempt to flow chart the machine code program for the RTTY modem. Although not strictly following all the rules of flow charting, this diagram should at least be an aid to understanding the logic of the program.



NOTES & ERRATA — RE PART 1

- R38 is actually 330R, not 10k as shown.
- Note that the LIMIT function operates when the SW2 contacts are open circuit.
- Check all toggle switch contact closures with a multimeter before wiring up. Some types have the toggle **towards** the on contact, others **away** from it. To check Rx mark/high-mark/low, station AXM transmits **mark low** (use USB) and is a good reference.

Eight data lines and a common ground connect the ETI-755 with its host computer. **Bit 7** is the send/receive switch, and is always programmed as an output with the DDR. Logic *low is send,* and *high is receive.*

Bit 6 is the strobe line (active low). It tells the transmitter to send, and resets the 'data available' indication from the receiver. It is always programmed as an output.

Bit 5 (active high) tells the computer that a new character is available during receive, and that the transmit buffer can accept a new character during send. It is always programmed as an input.

Bits 4 through 0 are the five teletype data bits, and the DDR sets them as either inputs or outputs depending on whether the system is receiving or sending.

When writing your software you must ensure you do things in the right order. When going into the receive mode, you must change the lower five DDR bits to INPUT before sending data bit 7, the send/receive switch, high. Likewise, when going into transmit you must set bit 7 low before making the data bits into OUTPUTS.

The UART has its input and output states as well, and if you have both the in/out chip and the UART trying to output to the same data lines, dire consequences (blown chips) could result.

Some notes on the program

I will not try to explain in detail how the program works. If you look at the flow chart you'll see why ... the program runs around in circles, jumps into subroutines and comes out as straight-line code, and generally makes a nuisance of itself. But it seems to work nicely.

When the program starts, it first reformats the screen for 25 character rows. That's 16 for the upper screen, one for the dotted line, and eight for the lower screen. The screen width has been kept at 64 characters to maintain compatibility with the older Microbees that would otherwise slop over the edges of their TV screens.

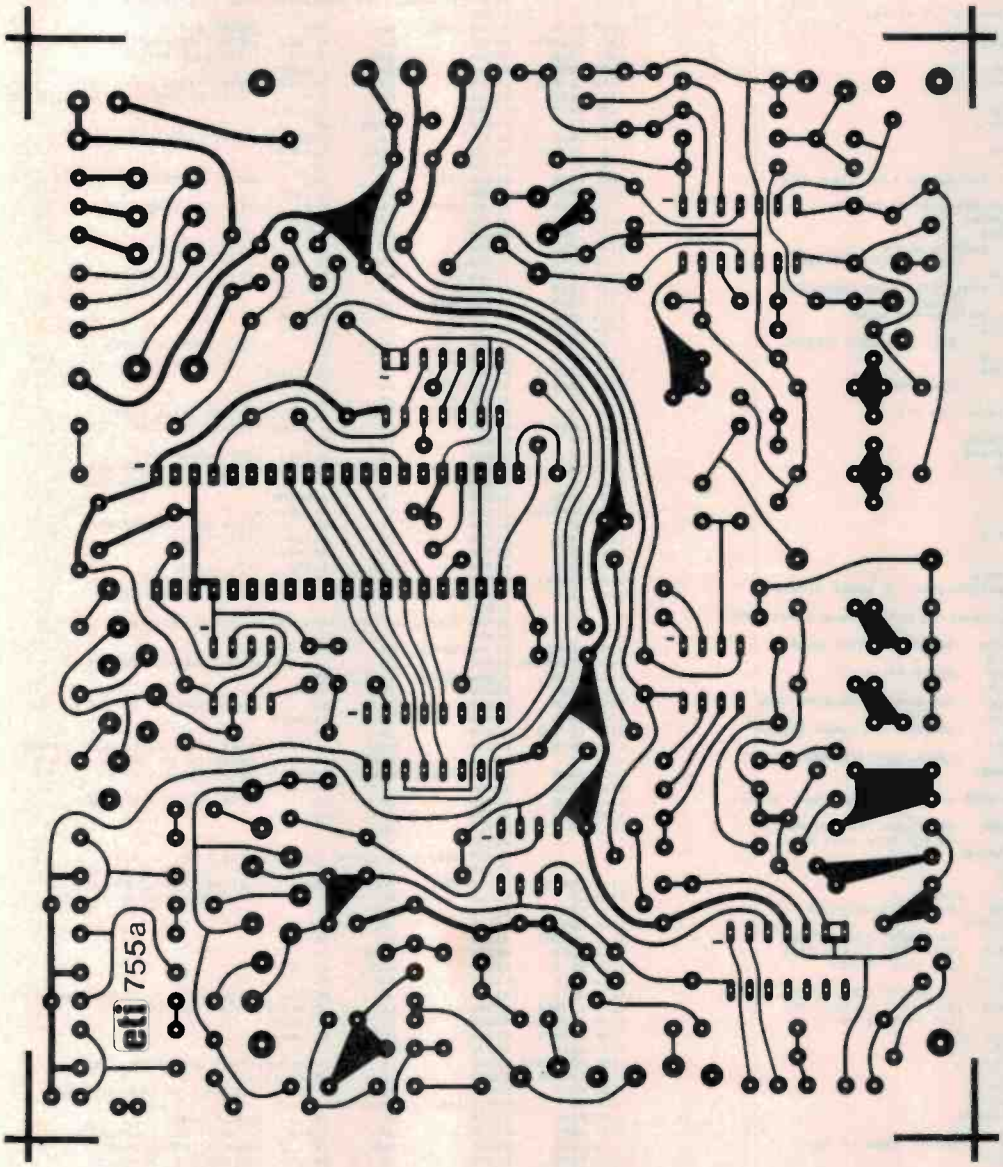
The program has what amounts to two mainlines, the receive stream on the left and the transmit stream on the right. It spends most of its time in one of the shaded loops, waiting for something to happen. When the proper keys are pressed, program control transfers from one side to the other, via that great jumping roundabout in the middle. The slack pointer has to be fiddled from time to time to change what started as a subroutine call into a straight out jump.

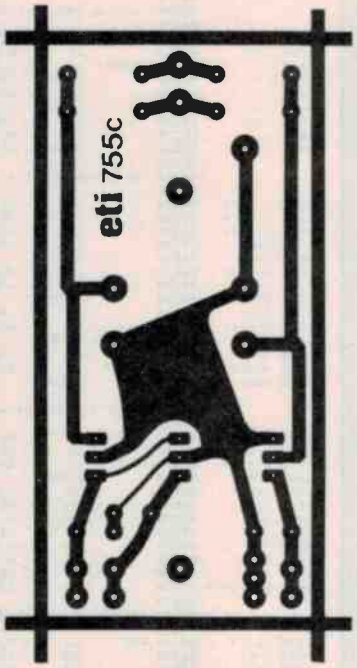
Understand it now? That's all right, I don't either most of the time and I wrote the damn thing!

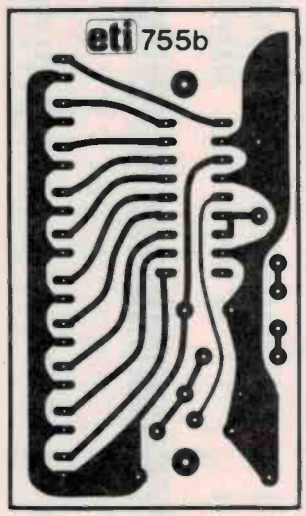
The program listing is presented in two parts: the source code and a hex dump the special character set. The lower case part of the character set isn't used in this program, but it's been included in the listing in case you want to use the whole character set for one of your own projects.

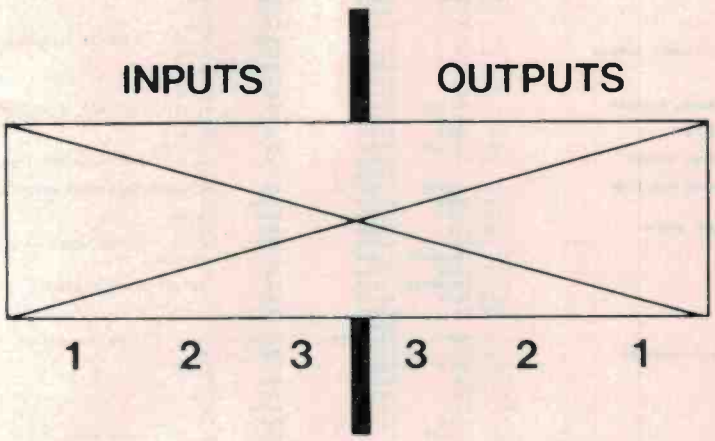
If you find this all a bit much and would prefer to get on with the RTTY, you can obtain a cassette of the entire program, ready to go (except for inserting your own station ident), for $18.50 post paid. Send your hard-earned bucks to *High-Tech, Tasmania, 39 Pillinger Drive, Fern Tree 7101.*

See you on the air! ▶


eti 755a


eti 755c

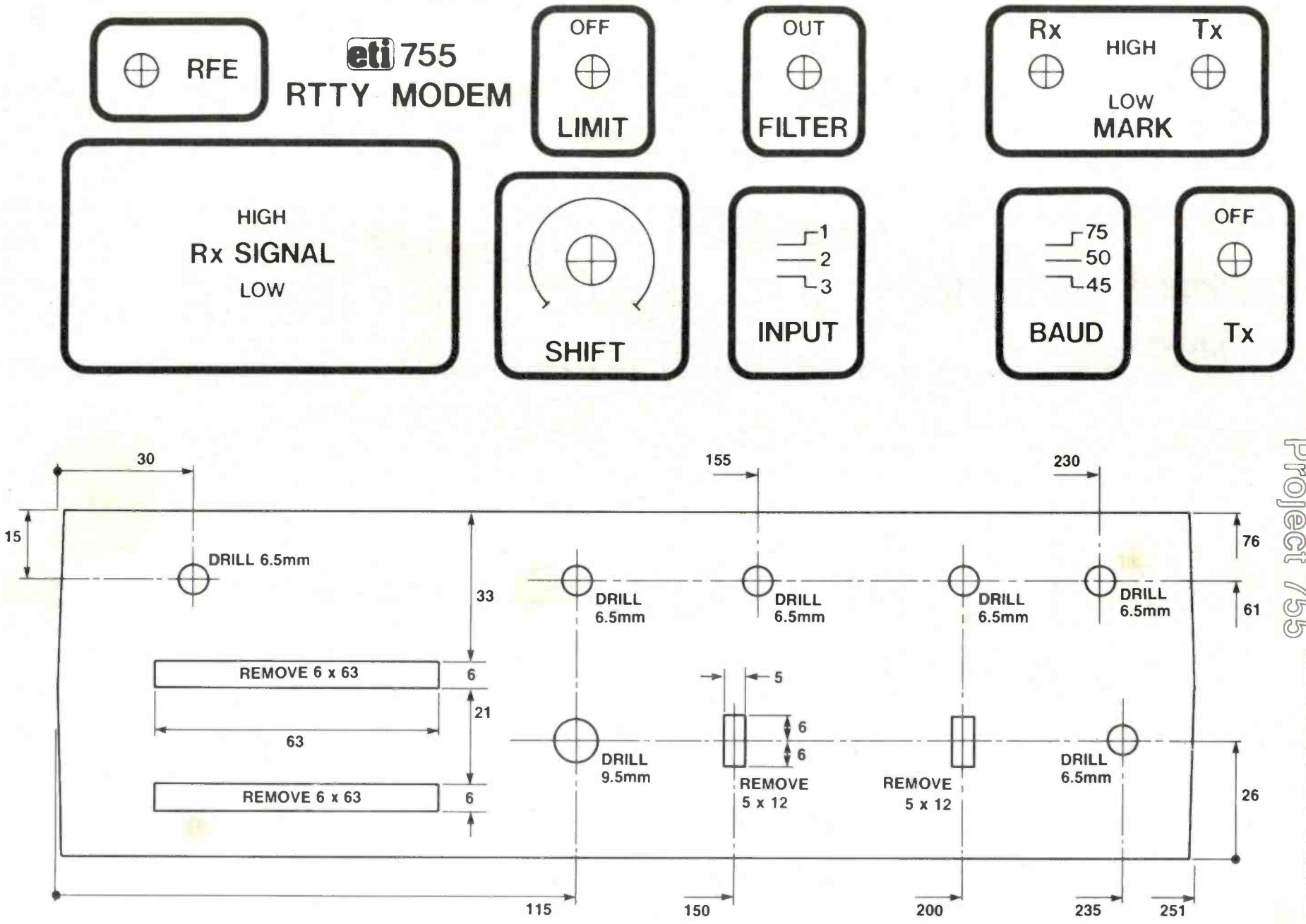

eti 755b


INPUTS
OUTPUTS
1
2
3
3
2
1


Tx RELAY
POWER

```
ADDR   CODE    LINE   LABEL  MNEM    OPERAND

                00100 ;ETI-755 / MICROBEE RADIOTELETYPE TRANSCEIVER
                00110 ;         -Tom Moffat, May 19, 1984
                00120
0400            00130          DEFR    1e
1000            00140          ORG     1000
1000 210010     00150          LD      HL,$     ;SET UP RESTART ADDRESS
1003 22A200     00160          LD      (0A2),HL
                00170
                00180 ;Set up CRT Controller for 25 lines.
                00190
1006 213B12     00200          LD      HL,CRC
1009 0605       00210          LD      B,5
100B 7E         00220 SETUP    LD      A,(HL)
100C D30C       00230          OUT     (0CH),A
100E 23         00240          INC     HL
100F 7E         00250          LD      A,(HL)
1010 D30D       00260          OUT     (0DH),A
1012 23         00270          INC     HL
1013 10F6       00280          DJNZ    SETUP
                00290
                00300 ;Draw dotted line, clear screen ram, clear PCG.
                00310
1015 2100F0     00320          LD      HL,0F000;START OF SCREEN
1018 1101F0     00330          LD      DE,0F001
101B 010004     00340          LD      BC,400
101E 36A0       00350          LD      (HL),0A0;PCG BLANK
1020 EDB0       00360          LDIR            ;FILL RECEIVE SCREEN
1022 014000     00370          LD      BC,40
1025 369E       00380          LD      (HL),9EH;DOTTED LINE CHARACTER
1027 EDB0       00390          LDIR            ;DRAW DOTTED LINE
1029 3620       00400          LD      (HL),20 ;NON-PCG BLANK
102B 01C003     00410          LD      BC,3C0
102E EDB0       00420          LDIR            ;FILL TRANSMIT SCREEN
1030 3600       00430          LD      (HL),0
1032 010006     00440          LD      BC,800
1035 EDB0       00450          LDIR            ;FILL PCG
                00460
                00470 ;Move 8-byte characters into PCG.
                00480
1037 212B15     00490          LD      HL,CHARS
103A 1100F8     00500          LD      DE,0F800
103D 010800     00510 MOVE     LD      BC,8
1040 EDB0       00520          LDIR
1042 3E08       00530          LD      A,8
1044 13         00540          INC     DE
1045 3D         00550          DEC     A
1046 20FC       00560          JR      NZ,$-2
1048 7A         00570          LD      A,D
1049 B7         00580          OR      A
104A 20F1       00590          JR      NZ,MOVE
104C DD213FF4   00600          LD      IX,0F43FH;START OF LOWER SCREEN
                00610
                00620 ;Enter receive mode, checking both keyboard and UART.
                00630
104E 3ECF       00640 RECV     LD      A,0CFH  ;SET PIO CONTROL MODE
1050 D301       00650          OUT     (1),A
1052 3E3F       00660          LD      A,3FH   ;DDR = 00111111
1054 D301       00670          OUT     (1),A
1056 3EC0       00680          LD      A,0C0   ;SET UART TO RECEIVE MODE
1058 D300       00690          OUT     (0),A
105A CD6811     00700 RXKEY    CALL    KEY     ;GET KEY FOR LOWER SCREEN
105D DB00       00710          IN      A,(0)
105F CB6F       00720          BIT     5,A     ;CHECK UART FOR NEW CHAR
1061 28F7       00730          JR      Z,RXKEY
                00740
                00750 ;Get character from UART and display on upper screen.
                00760
1063 CD5F11     00770          CALL    STROBE  ;RESET DAV FLAG IN UART
1066 E61F       00780          AND     1FH     ;SELECT DATA BITS ONLY
1068 211512     00790          LD      HL,RXTAB
106B 1600       00800          LD      D,0
106D 5F         00810          LD      E,A
106E CB23       00820          SLA     E       ;E=E*2
1070 19         00830          ADD     HL,DE   ;ADD CHR TO POINTER
1071 110613     00840          LD      DE,FLAG2
1074 FE1B       00850          CP      1BH     ;IS BAUDOT CODE (FIGS) ?
1076 2003       00860          JR      NZ,$+5  ;SKIP NEXT IF NOT FIGS
1078 3E01       00870          LD      A,1     ;SET FLAG "FIGS"
107A 12         00880          LD      (DE),A
107B FE1F       00890          CP      1FH     ;IS BAUDOT CODE (LTRS) ?
107D 2002       00900          JR      NZ,$+4  ;SKIP NEXT IF NOT LTRS
107F AF         00910          XOR     A       ;SET FLAG "LTRS"
1080 12         00920          LD      (DE),A
1081 EB         00930          EX      DE,HL
1082 6E         00940          LD      L,(HL)
1083 2600       00950          LD      H,0
1085 19         00960          ADD     HL,DE
1086 5E         00970          LD      E,(HL)
1087 3A0713     00980          LD      A,(FLAG3)
108A B3         00990          OR      E
108B CD4280     01000          CALL    8042    ;OUTPUT CHAR TO VDU.
108E 18CA       01010          JR      RXKEY
                01020
1090 DB00       01030 RXJMP    IN      A,(0)   ;TEST TX/RX SWITCH
1092 E680       01040          AND     80
1094 C0         01050          RET     NZ      ;IF ALREADY IN RECV MODE
1095 D1         01060          POP     DE      ;CLEAR RET ADDR FROM STACK
1096 CD1211     01070          CALL    CRLF
1099 CD2D12     01080          CALL    LTRS
109C 1860       01090          JR      RECV
                01100
109E 210A13     01110 BRGRD    LD      HL,BRGST;MOVE BRAG TAPE TO LOWER SCREEN
10A1 1140F4     01120          LD      DE,0F440
10A4 010802     01130          LD      BC,200
10A7 EDB0       01140          LDIR
10A9 DD2A0813   01150          LD      IX,(BRGIX)      ;GET KEYBOARD POINTER
                01160
                01170 ;Enter transmit mode while checking keyboard.
                01180
10AD FD2140F4   01190 AUTOTX   LD      IY,0F440;FROM START OF LOWER SCREEN
10B1 1807       01200          JR      TX
10B3 CDCE11     01210 MANUTX   CALL    CR      ;FROM PRESENT CURSOR POSITION
10B6 DDE5       01220          PUSH    IX
10B8 FDE1       01230          POP     IY
10BA D1         01240 TX       POP     DE      ;CLEAR RET ADDR OFF STACK
10BB CD2112     01250          CALL    TXINIT
10BE CD1211     01260          CALL    CRLF
10C1 CD6811     01270 TX1      CALL    KEY
10C4 DDE5       01280          PUSH    IX
10C6 E1         01290          POP     HL
10C7 FDE5       01300          PUSH    IY
10C9 D1         01310          POP     DE
10CA ED52       01320          SBC     HL,DE
10CC 38F3       01330          JR      C,TX1   ;IF KEY POINTER = TX POINTER
10CE FD7E00     01340          LD      A,(IY)
10D1 CB7F       01350          BIT     7,A
10D3 C4F710     01360          CALL    NZ,SEND ;IF NOT A BLANK
10D6 FD23       01370          INC     IY
10D8 18E7       01380          JR      TX1
                01390
10DA D1         01400 KEPT     POP     DE      ;CLEAR STACK
10DB CD2112     01410          CALL    TXINIT

10DE CD1211     01420          CALL    CRLF
10E1 FD2140F4   01430 REPT1    LD      IY,0F440;START OF LOWER SCREEN
10E5 FD7E00     01440 REPT2    LD      A,(IY)
10E8 CDF710     01450          CALL    SEND
10EB FD23       01460          INC     IY
10ED FDCB007E   01470          BIT     7,(IY)
10F1 20F2       01480          JR      NZ,REPT2
10F3 18EC       01490          JR      REPT1
                01500
                01510 ;Transmit one character from lower screen.
                01520
10F5 E67F       01530 SEND     AND     7FH     ;RESET BIT 7
10F7 21E200     01540          LD      HL,0E2  ;OUTPUT REDIRECTION
10FA CB6E       01550          BIT     5,(HL)  ;1200 BAUD PRINT
10FC 280E       01560          JR      Z,NOPRT
10FE CD7FA8     01570          CALL    0A87FH  ;DIRECT 1200 BAUD ROUTINE
1101 FE0D       01580          CP      0DH     ;ASCII RETURN
1103 2007       01590          JR      NZ,NOPRT
1105 F5         01600          PUSH    AF
1106 3E0A       01610          LD      A,0AH   ;ASCII LINEFEED
1108 CD7FA8     01620          CALL    0A87FH
110B F1         01630          POP     AF
110C FE0D       01640 NOPRT    CP      0DH     ;ASCII RETURN
110E 2007       01650          JR      NZ,$+9
1110 1E08       01660 CRLF     LD      E,8     ;TTY (CR) CHARACTER
1112 CD4911     01670          CALL    SEND1
1115 1804       01680          JR      $+6
1117 FE0A       01690          CP      0AH     ;ASCII LINE FEED
1119 2004       01700          JR      NZ,BELL
111B 1E02       01710          LD      E,2     ;TTY (LF) CHARACTER
111D 1828       01720          JR      SEND1
111F FE07       01730 BELL     CP      7
1121 2002       01740          JR      NZ,$+4
1123 3E5F       01750          LD      A,5FH
1125 D620       01760          SUB     20      ;KILL CONTROL CODES
1127 D8         01770          RET     C
1128 21C512     01780          LD      HL,TXTAB
112B 1600       01790          LD      D,0
112D 5F         01800          LD      E,A
112E 19         01810          ADD     HL,DE   ;HL HAS TXTAB ENTRY
112F 3A0513     01820          LD      A,(FLAG1);FIGS/LTRS FLAG
1132 5F         01830          LD      E,A
1133 7E         01840          LD      A,(HL)  ;TTY CHARACTER
1134 E680       01850          AND     80      ;SELECT FIGS/LTRS BIT
1136 BB         01860          CP      E       ;COMPARE PREVIOUS FLAG
1137 200D       01870          JR      Z,NOSHFT
1139 320513     01880          LD      (FLAG1),A
113C B7         01890          OR      A       ;FIGS OR LTRS NEEDED?
113D 1E1B       01900          LD      E,1BH   ;TTY (FIGS)
113F 2002       01910          JR      NZ,$+4
1141 1E1F       01920          LD      E,1FH   ;TTY (LTRS)
1143 CD4911     01930          CALL    SEND1
1146 5E         01940 NOSHFT   LD      E,(HL)  ;GET TTY CHARACTER
                01950
                01960 ;Send the TTY character in the E register.
                01970
1147 FD4E00     01980 SEND1    LD      C,(IY)
114A FD3600FF   01990          LD      (IY),0FF ;SHOW TRANSMIT CURSOR
114E CD6811     02000 SEND2    CALL    KEY
1151 DB00       02010          IN      A,(0)
1153 CB6F       02020          BIT     5,A     ;UART TRANSMIT BUFFER EMPTY?
1155 28F7       02030          JR      Z,SEND2
1157 FD7100     02040          LD      (IY),C
115A 3E1F       02050          LD      A,1FH   ;00011111, SET TX MODE & MASK
115C A3         02060          AND     E       ;MERGE IN TTY CHAR
115D E6BF       02070 STROBE   AND     0BFH    ;SEND STROBE BIT LOW
115F D300       02080          OUT     (0),A
1161 F640       02090          OR      40      ;SEND STROBE BIT HIGH
1163 D300       02100          OUT     (0),A
1165 C9         02110          RET
                02120
                02130 ;Get a keyboard input for the lower screen.
                02140
1166 CD0900     02150 KEY      CALL    0009    ;GET KEY FOR LOWER SCREEN
1169 C8         02160          RET     Z       ;IF NO KEY PRESSED
116A D9         02170          EXX
116B DD23       02180          INC     IX
116D 11C009     02190          LD      DE,9C0
1170 DDE5       02200          PUSH    IX
1172 DD19       02210          ADD     IX,DE
1174 DDE1       02220          POP     IX
1176 3814       02230          JR      NC,VDU  ;IF NOT END OF LOWER SCREEN
1178 1140F4     02240          LD      DE,0F440;SCROLL ROUTINE
117B 2180F4     02250          LD      HL,0F480
117E 010002     02260          LD      BC,200
1181 EDB0       02270          LDIR
1183 DD2100F0   02280          LD      IX,0F000;START OF BOTTOM LINE
1187 11C0FF     02290          LD      DE,0FFC0
118A FD19       02300          ADD     IY,DE   ;SUBTRACT 40 FROM TX CURSOR
118C D9         02310 VDU      EXX
118D FE60       02320          CP      60      ;LOWER CASE?
118F 3802       02330          JR      C,$+4   ;SKIP IF NOT LOWER CASE
1191 D620       02340          SUB     20      ;MAKE IT LOWER CASE
1193 F680       02350          OR      80      ;SELECT PCG CHARACTER
1195 DD7700     02360          LD      (IX),A  ;SHOW THE CHARACTER
1198 FE0A       02370          CP      0AH
119A D0         02380          RET     NC      ;IF NOT A CONTROL CHARACTER
119B 214512     02390          LD      HL,JMPTBL
119E CB27       02400          SLA     A
11A0 E63F       02410          AND     3FH
11A2 1600       02420          LD      D,0
11A4 5F         02430          LD      E,A
11A5 19         02440          ADD     HL,DE   ;COMPUTE JUMP DESTINATION
11A6 5E         02450          LD      E,(HL)
11A7 23         02460          INC     HL
11A8 56         02470          LD      D,(HL)
11A9 EB         02480          EX      DE,HL
11AA FD7E00     02490          LD      A,(IY)  ;GET RID OF TX CURSOR
11AD FE80       02500          CP      80
11AF 2003       02510          JR      NZ,$+5
11B1 FD7700     02520          LD      (IY),C
11B4 E9         02530          JP      (HL)    ;GOTO CONTROL FUNCTION
                02540
11B5 11BF0B     02550 BS       LD      DE,0BBFH;BACKSPACE ROUTINE
11B8 DDE5       02560          PUSH    IX
11BA DD19       02570          ADD     IX,DE
11BC DDE1       02580          POP     IX
11BE D0         02590          RET     NC      ;IF BS WOULD GO ONTO DOTTED LINE
11BF DD3600200  02600          LD      (IX),20
11C3 DD2B       02610          DEC     IX
11C5 DD360080   02620          LD      (IX),80 ;LITTLE ARROW
11C9 DD2B       02630          DEC     IX
11CB C9         02640          RET
                02650
11CC DDE5       02660 CR       PUSH    IX      ;CARRIAGE RETURN ROUTINE
11CE D1         02670          POP     DE
11CF 3EC0       02680          LD      A,0C0
11D1 A3         02690          AND     E
11D2 5F         02700          LD      E,A
11D3 D5         02710          PUSH    DE
11D4 DDE1       02720          POP     IX
11D6 113F00     02730 LF       LD      DE,3FH  ;LINE FEED
11D9 DD19       02740          ADD     IX,DE
11DB C9         02750          RET
```

```
                02760
11DE 213FF6     02770 DEL       LD      HL,0F63FH;CLEAR LOWER SCREEN
11E1 113EF6     02780           LD      DE,0F63EH
11E4 01FF01     02790           LD      BC,1FFH
11E7 3620       02800           LD      (HL),20 ;NON-PCG BLANK
11E9 EDB8       02810           LDDR
11EB D5         02820           PUSH    DE
11EC DDE1       02830           POP     IX      ;SET VDU POINTER TO START
11EE C9         02840           RET
                02850
11EF 210713     02860 TAPE      LD      HL,FLAG3;UPPER SCREEN TAPE OR PAGE MOD
11F2 3E00       02870           LD      A,00
11F4 180C       02880           JR      TOGGLE
                02890
11F6 210413     02900 CASE      LD      HL,FLAG2;FORCE FIGS/LTRS SHIFT
11F9 3E01       02910           LD      A,1
11FB 1805       02920           JR      TOGGLE
                02930
11FD 21E200     02940 PRINTR    LD      HL,0E2  ;PRINTER ON OR OFF
1200 3E20       02950           LD      A,20
1202 AE         02960 TOGGLE    XOR     (HL)
1203 77         02970           LD      (HL),A
1204 C9         02980           RET
                02990
1205 DD220813   03000 BRGWR     LD      (BRGIX),IX;RECORD BRAG TAPE
1209 2140F4     03010           LD      HL,0F440
120C 110A13     03020           LD      DE,BRGST
120F 010002     03030           LD      BC,200
1212 EDB0       03040           LDIR
1214 C9         03050           RET
                03060
1215 210A15     03070 IDENT     LD      HL,IDENST;SEND THE STATION CALL SIGN
1218 7E         03080           LD      A,(HL)
1219 B7         03090           OR      A       ;NULL CHARACTER?
121A C8         03100           RET     Z
121B CD6B11     03110           CALL    KEY+3
121E 23         03120           INC     HL
121F 18F7       03130           JR      IDENT+3
                03140
1221 3E40       03150 TXINIT    LD      A,40    ;01000000
1223 D300       03160           OUT     (0),A   ;SET UART FOR TX
1225 3ECF       03170           LD      A,0CFH  ;SET PIO FOR CONTROL MODE
1227 D301       03180           OUT     (1),A
1229 3E20       03190           LD      A,20    ;DDR = 00100000
122B D301       03200           OUT     (1),A
122D 1E1F       03210 LTRS      LD      E,1FH   ;TTY 'LTRS' CHR.
122F 0608       03220           LD      B,8
1231 CD4911     03230           CALL    SEND1
1234 10FB       03240           DJNZ    $-3
1236 AF         03250           XOR     A
1237 320513     03260           LD      (FLAG1),A
123A C9         03270 DUMMY     RET             ;FOR UNASSIGNED JUMP DESTINATIONS
                03280
123B 041E       03290 CRC       DEFW    1E04    ;DATA FOR CRT CONTROLLER
1230 0502       03300           DEFW    205
123F 0619       03310           DEFW    1906
1241 0718       03320           DEFW    1807
1243 0909       03330           DEFW    909
                03340
1245 3A12       03350 JMPTBL    DEFW    DUMMY   ;00      ^@
1247 AF10       03360           DEFW    AUTOTX  ;01      ^A
1249 A810       03370           DEFW    BRGRD   ;02      ^B
124B 9210       03380           DEFW    RxJMP   ;03      ^C
124D 3A12       03390           DEFW    DUMMY   ;04      ^D
124F 3A12       03400           DEFW    DUMMY   ;05      ^E
1251 F611       03410           DEFW    CASE    ;06      ^F
1253 3A12       03420           DEFW    DUMMY   ;07      BELL
1255 B711       03430           DEFW    BS      ;08      BACKSPACE
1257 1512       03440           DEFW    IDENT   ;09      ^I
1259 D811       03450           DEFW    LF      ;0A      LINE FEED
125B 3A12       03460           DEFW    DUMMY   ;0B      ^K
125D 3A12       03470           DEFW    DUMMY   ;0C      ^L
125F CE11       03480           DEFW    CR      ;0D      CARRIAGE RETURN
1261 3A12       03490           DEFW    DUMMY   ;0E      ^N
1263 3A12       03500           DEFW    DUMMY   ;0F      ^O
1265 FD11       03510           DEFW    PRINTR  ;10      ^P
1267 3A12       03520           DEFW    DUMMY   ;11      ^Q
1269 DC10       03530           DEFW    REPT    ;12      ^R
126B B510       03540           DEFW    MANUTX  ;13      ^S
126D EF11       03550           DEFW    TAPE    ;14      ^T
126F 3A12       03560           DEFW    DUMMY   ;15      ^U
1271 3A12       03570           DEFW    DUMMY   ;16      ^V
1273 0512       03580           DEFW    BRGWR   ;17      ^W
1275 3A12       03590           DEFW    DUMMY   ;18      ^X
1277 3A12       03600           DEFW    DUMMY   ;19      ^Y
1279 3A12       03610           DEFW    DUMMY   ;1A      ^Z
127B 3A12       03620           DEFW    DUMMY   ;1B      ^[
127D 3A12       03630           DEFW    DUMMY   ;1C      ^\
127F 3A12       03640           DEFW    DUMMY   ;1D      ^]
1281 3A12       03650           DEFW    DUMMY   ;1E      ^^
1283 DE11       03660           DEFW    DEL     ;1F      ^ DELETE
                03670
                03680 ;ASCII lookup table arranged by BAUDOT value
                03690
1285 1C1C       03700 RXTAB     DEFW    1C1CH   ;(BLANK)
1287 C5B3       03710           DEFW    0B3C5   ;E 3
1289 0A0A       03720           DEFW    0A0AH   ;(LF)
128B C1AD       03730           DEFW    0ADC1   ;A -
128D AAA8       03740           DEFW    0A8AA   ;(SPACE)
128F D3A7       03750           DEFW    0A7D3   ;S '
1291 C9BB       03760           DEFW    0BBC9   ;I 8
1293 D5B7       03770           DEFW    0B7D5   ;U 7
1295 0D0D       03780           DEFW    0D0DH   ;(CR)
1297 C4A4       03790           DEFW    0A4C4   ;D $
1299 D2B4       03800           DEFW    0B4D2   ;R 4
129B CA07       03810           DEFW    7CAH    ;J (BELL)
129D CEAC       03820           DEFW    0ACCEH  ;N ,
129F C6A5       03830           DEFW    0A5C6   ;F %
12A1 C3B4       03840           DEFW    0B4C3   ;C :
12A3 C6A8       03850           DEFW    0A8C6H  ;K (
12A5 D4B5       03860           DEFW    0B5D4   ;T 5
12A7 0AA2       03870           DEFW    0A20AH  ;Z "
12A9 CCA9       03880           DEFW    0A9CCH  ;L )
12AB D7B2       03890           DEFW    0B2D7   ;W 2
12AD C8A3       03900           DEFW    0A3C8   ;H (STOP)
12AF D9A6       03910           DEFW    0A6D9   ;Y 6
12B1 D0B0       03920           DEFW    0B0D0   ;P 0
12B3 D1B1       03930           DEFW    0B1D1   ;Q 1
12B5 CFB9       03940           DEFW    0B9CFH  ;O 9
12B7 C2BF       03950           DEFW    0BFC2   ;B ?
12B9 C7A4       03960           DEFW    0A4C7   ;G &
12BB 1919       03970           DEFW    1919    ;(FIGS)
12BD CDAE       03980           DEFW    0AECDH  ;M .
12BF D8AF       03990           DEFW    0AFD8   ;X /
12C1 DABD       04000           DEFW    0BDDA   ;V =
12C3 1A1A       04010           DEFW    1a1aH   ;(LTRS)
                04020
                04030 ;Baudot character table, arranged by ASCII value.
                04040
12C5 049C       04050 TXTAB     DEFW    9C04    ;(SPC) '
12C7 9594       04060           DEFW    9485    ;" #
12C9 9A8D       04070           DEFW    8D9AH   ;$ %
12CB 8085       04080           DEFW    8580H   ;& -
12CD 8F92       04090           DEFW    928FH   ;( )
12CF 1DY1       04100           DEFW    911DH   ;* +
12D1 8C83       04110           DEFW    838CH   ;, -
12D3 9C9D       04120           DEFW    9D9CH   ;. /
12D5 9697       04130           DEFW    9796    ;0 1
12D7 9381       04140           DEFW    8193    ;2 3
12D9 8A96       04150           DEFW    968AH   ;4 5
12DB 958        04160           DEFW    8795    ;6 7
12DD 8698       04170           DEFW    9886    ;8 9
12DF 8E8C       04180           DEFW    8C8EH   ;: ;
12E1 8F9E       04190           DEFW    9E8FH   ;< =
12E3 9299       04200           DEFW    9992    ;> ?
12E5 8B03       04210           DEFW    38BH    ;@ A
12E7 190E       04220           DEFW    0E19    ;B C
12E9 0901       04230           DEFW    109     ;D E
12EB 0D1A       04240           DEFW    1A0DH   ;F G
12ED 1486       04250           DEFW    614     ;H I
12EF 8B0F       04260           DEFW    0F8BH   ;J K
12F1 121C       04270           DEFW    1C12    ;L M
12F3 0C1B       04280           DEFW    180CH   ;N O
12F5 1617       04290           DEFW    1716    ;P Q
12F7 0A85       04300           DEFW    58AH    ;R S
12F9 1007       04310           DEFW    710     ;T U
12FB 1E13       04320           DEFW    131EH   ;V W
12FD 1D15       04330           DEFW    1510H   ;X Y
12FF 110F       04340           DEFW    8F11    ;Z [
1301 9D92       04350           DEFW    929DH   ;\ ]
1303 8B8B       04360           DEFW    8B8BH   ;^ _
                04370
1305 00         04380 FLAG1     DEFB    0
1306 00         04390 FLAG2     DEFB    0
1307 00         04400 FLAG3     DEFB    0
1308 40F4       04410 BRGIX     DEFW    0F440
0200            04420 BRGST     DEFS    200
150A 44         04430 IDENST    DEFM    'DE VK7XYZ COOLANGATTA QUEENSLAND'
152A 00         04440           DEFB    0
1528            04450 CHARS     EQU     $       ;CHARACTER SET GOES HERE
0000            04460           END
00000 Total errors

DUMMY   123A    IDENST  150A    IDENT   1215    BRGWR   1205
PRINTR  11FD    CASE    11F6    TOGGLE  1202    TAPE    11EF
DEL     11DE    LF      11D8    BS      11B7    JMPTBL  1245
VDU     110E    SEND2   1150    NOSHFT  1148    FLAG1   1305
TXTAB   12C5    BELL    1121    SEND1   1149    NOPRT   110E
REPT2   10E7    REPT1   10E3    REPT    10DC    SEND    10F7
TXI     10C3    TXINIT  1221    CR      11CE    MANUTX  10B5
TX      10BC    AUTOTX  10AF    BRGIX   1308    BRGST   130A
BRGRD   10A0    LTRS    122D    CRLF    1112    RXJMP   1092
FLAG3   1307    FLAG2   1306    RXTAB   1285    STROBE  115F
KEY     116B    RXKEY   105C    RECV    1050    MOVE    103D
CHARS   1528    SETUP   100B    CRC     123B

Upper case letters.

1728   38 44 54 5C  58 40 3C 00  10 28 44 44  7C 44 44 00
1738   F8 44 44 78  44 44 F8 00  38 44 40 40  40 44 38 00
1748   F8 44 44 44  44 44 F8 00  7C 40 40 78  40 40 7C 00
1758   7C 40 40 78  40 40 40 00  38 44 40 40  4E 44 3C 00
1768   44 44 44 7C  44 44 44 00  38 10 10 10  10 10 38 00
1778   0E 04 04 04  04 44 38 00  44 48 50 70  50 48 44 00
1788   40 40 40 40  40 40 7C 00  C6 AA 92 92  82 82 82 00
1798   44 44 64 54  4C 44 44 00  38 44 44 44  44 44 38 00
17A8   78 44 44 78  40 40 40 00  38 44 44 44  54 48 34 00
17B8   78 44 44 78  50 48 44 00  38 44 40 38  04 44 38 00
17C8   7C 10 10 10  10 10 10 00  44 44 44 44  44 44 38 00
17D8   44 44 44 28  28 10 10 00  82 82 82 92  92 AA C6 00
17E8   44 44 28 10  28 44 44 00  44 44 44 28  10 10 10 00
17F8   7C 04 08 10  20 40 7C 00  7C 40 40 40  40 40 7C 00
1808   00 40 20 10  08 04 00 00  7C 04 04 04  04 04 7C 00
1818   00 00 10 20  44 00 00 00  FF C3 BD 81  DB 99 FF 00

Lower case letters (not used in RTTYTX program).

1828   20 10 08 00  00 00 00 00  00 00 38 04  3C 44 3C 00
1838   40 40 78 44  44 44 78 00  00 00 3C 40  40 40 3C 00
1848   04 04 3C 44  44 44 3C 00  00 00 38 44  7C 40 38 00
1858   0C 10 10 7C  10 10 10 00  00 00 3C 44  44 3C 04 38
1868   40 40 78 44  44 44 44 00  10 00 30 10  10 10 38 00
1878   10 00 10 10  10 10 10 60  20 20 24 28  30 28 24 00
1888   30 10 10 10  10 10 38 00  00 00 EC 92  92 92 92 00
1898   00 00 78 44  44 44 44 00  00 00 38 44  44 44 38 00
18A8   00 00 78 44  44 78 40 40  00 00 3C 44  44 3C 04 04
18B8   00 00 2C 30  20 20 20 00  00 00 3C 40  38 04 78 00
18C8   10 10 7C 10  10 10 0C 00  00 00 44 44  44 44 3C 00
18D8   00 00 44 44  28 28 10 00  00 00 82 92  92 92 6C 00
18E8   00 00 44 28  10 28 44 00  00 00 44 44  44 3C 04 38
18F8   00 00 7C 08  10 20 7C 00  08 10 10 20  10 10 08 00
1908   10 10 10 00  10 10 10 00  20 10 10 08  10 10 20 00
1918   00 00 32 4C  00 00 00 00  28 54 28 54  28 54 28 00

DE VK7XYZ COOLANGATTA QUEENSLAND - Data for IDENST.

150A   44 45 20 56  4B 37 58 59  5A 20 43 4F  4F 4C 41 4E
151A   47 41 54 54  41 20 51 55  45 45 4E 53  4C 41 4E 44

CHARACTER SET: Control characters.

1528   FF 81 BD A5  BD 81 FF 00  FF E7 DB BD  81 BD BD FF
1538   FF 83 BD 81  BD BD 83 FF  FF C3 BD BF  BF BD C3 FF
1548   FF 83 BD BD  BD BD 83 FF  FF 81 BF 87  BF BF 81 FF
1558   FF 81 BF 87  BF BF BF FF  FF C3 BD 81  DB 99 FF 00
1568   00 18 30 7E  30 11 01 00  FF E3 F7 F7  F7 F7 E3 FF
1578   FF C3 FF C3  FF C3 FF 00  FF DB D7 CF  D7 DB DB FF
1588   FF BF BF BF  BF BF 81 FF  FF EF DF 83  DF EF FF 00
1598   FF BD 9D AD  B5 B9 BD FF  FF C3 BD BD  BD BD C3 FF
15A8   FF 83 BD BD  83 BF BF FF  FF C3 BD BD  B5 B9 81 FF
15B8   FF 83 BD BD  83 B7 BB FF  FF C3 BF C3  FD FD C3 FF
15C8   7F 41 77 77  77 77 77 7F  FF BD BD BD  BD BD C3 FF
15D8   FF BD BD BD  BD DB E7 FF  FF BD BD BD  BD A5 DB FF
15E8   FF BD DB E7  E7 DB BD FF  FF F7 E3 D5  F7 F7 FF 00
15F8   FF F7 F7 D5  E3 F7 FF 00  AA 55 AA 55  AA 55 AA 55
1608   FF C3 A5 99  A5 C3 FF 00  AA 55 AA 55  AA 55 AA 55
1618   00 00 00 AA  00 00 00 00  AA 55 AA 55  AA 55 AA 55

Numbers and punctuations.

1628   00 00 00 00  00 00 00 00  10 10 10 10  10 00 10 00
1638   24 24 24 00  00 00 00 00  24 24 7E 24  7E 24 24 00
1648   10 3C 50 38  14 78 10 00  60 64 08 10  20 4C 0C 00
1658   10 28 28 10  2A 44 3A 00  10 10 10 00  00 00 00 00
1668   10 20 40 40  40 20 10 00  10 08 04 04  04 08 10 00
1678   10 54 38 10  38 54 10 00  00 10 10 7C  10 10 00 00
1688   00 00 00 00  00 10 10 20  00 00 00 7C  00 00 00 00
1698   00 00 00 00  00 00 10 00  00 04 08 10  20 40 00 00
16A8   38 44 4C 54  64 44 38 00  10 30 10 10  10 10 38 00
16B8   38 44 04 18  20 40 7C 00  7C 04 08 18  04 44 38 00
16C8   08 18 28 48  7C 08 00 00  7C 40 78 04  04 44 38 00
16D8   1C 20 40 78  44 44 38 00  7C 04 08 10  20 20 20 00
16E8   38 44 44 38  44 44 38 00  38 44 44 3C  04 08 70 00
16F8   00 00 10 00  10 00 00 00  00 00 00 10  00 10 10 20
1708   08 10 20 40  20 10 08 00  00 00 7C 00  7C 00 00 00
1718   20 10 08 04  08 10 20 00  38 44 04 18  10 00 10 00
```


RFE
eti 755
RTTY MODEM
OFF
LIMIT
OUT
FILTER
Rx
HIGH
Tx
LOW
MARK
HIGH
Rx SIGNAL
LOW
SHIFT
1
2
3
INPUT
75
50
45
BAUD
OFF
Tx
30
155
230
15
DRILL 6.5mm
33
76
61
DRILL 6.5mm
DRILL 6.5mm
DRILL 6.5mm
DRILL 6.5mm
REMOVE 6 x 63
6
21
63
REMOVE 6 x 63
6
5
6
6
DRILL 9.5mm
REMOVE 5 x 12
REMOVE 5 x 12
DRILL 6.5mm
26
115
150
200
235
251

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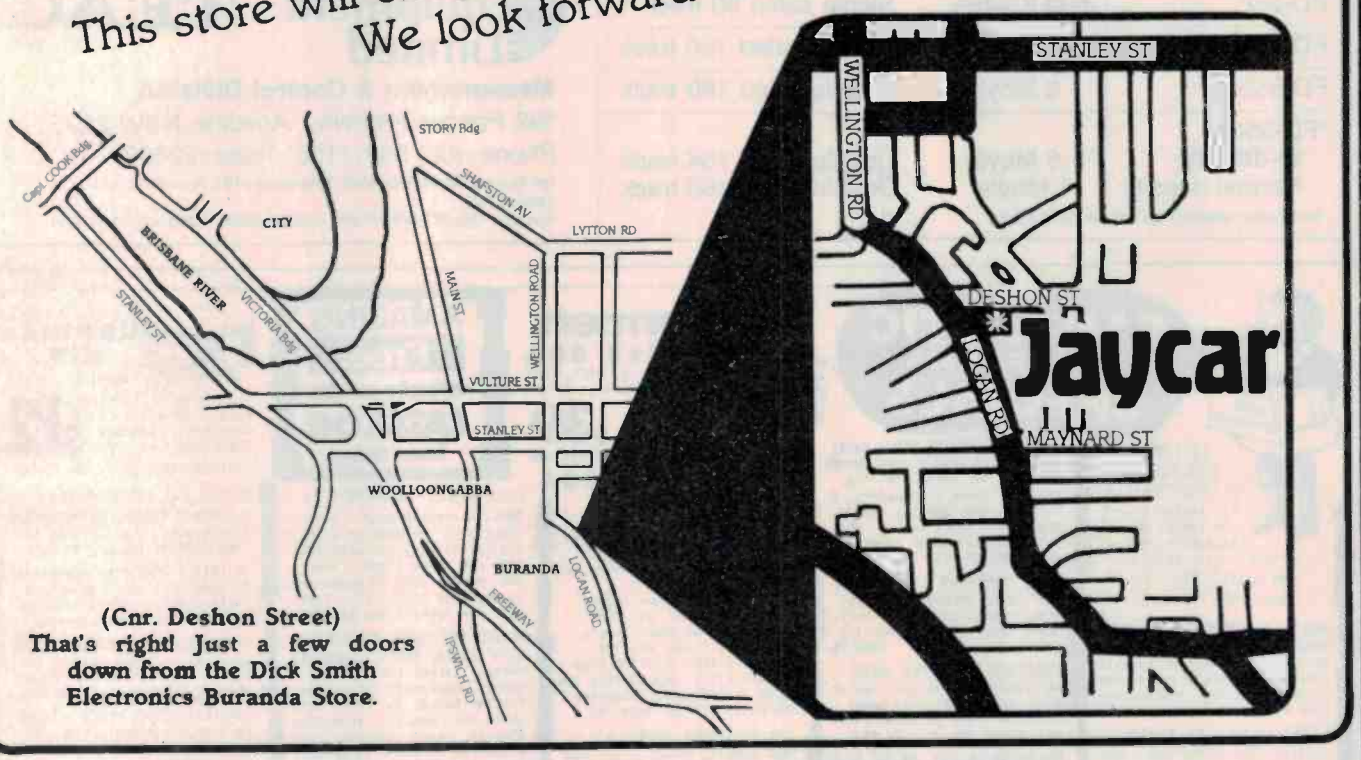

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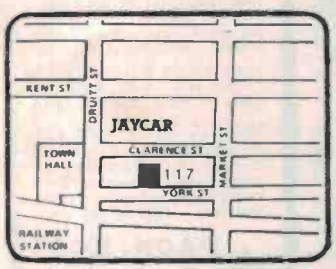

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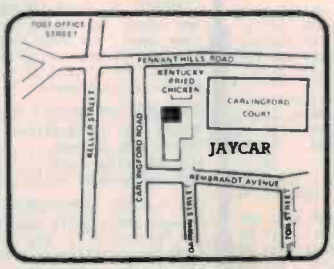

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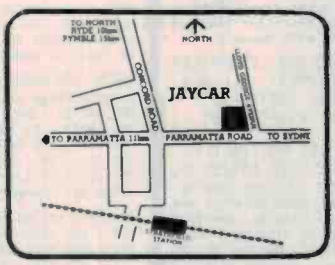

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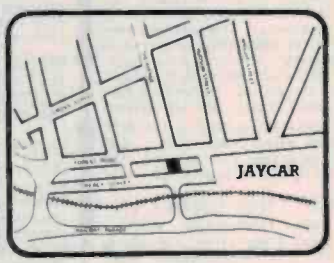

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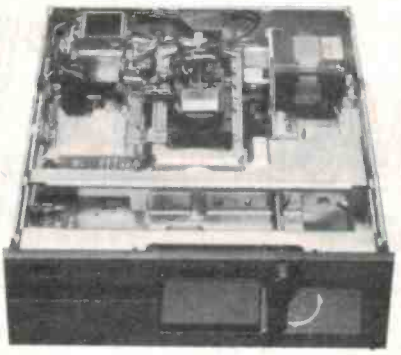

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The first Hobart personal computer exhibition

My feet hurt! It's been a long and tiring four days of talking, looking, working, playing, and generally doing things with computers. During this time some 5000 people have strolled through the Hobart City Hall to see and fiddle with some of the latest that technology has to offer. The number of people might not seem that big, but after all, it's a first, and 5000 is a fair proportion of Hobart's population.

We've had computer shows before, but shows of the past have featured the big, beautiful, super-expensive computer systems. Great for the up and coming multi-national company, but the average member of the public can only dream of these things. This latest effort, held during the last week of September, was aimed straight at the individual computer owner. The gear on show was that which could end up in a person's home, or small business. Many people bought computers as a result of the show, and some even got free ones (a Macintosh went off as the door prize on the final night).

I thought the most impressive graphics offering at the show was a Toshiba office system that produced on the screen a butterfly, a ladybird, and an ant. Good, clear images and true colour, not exaggerated colour as in some other systems. But, in an office situation, what's it good for? Butterflies for the bosses? Or maybe colour pie charts? One wonders if this love affair with colour graphics isn't being taken too far in machines that will see most of their service as word processors, spread sheets, or data bases.

Colour was again very evident at the Sleebs Computer stand. They had a NEC machine running a computer aided design package, connected to a Roland DXY-800 eight pen colour plotter. It was a fascinating gadget to watch, as the little clip picked up a pen from the side and whizzed back to draw a bit of a picture. Then it would put that pen back, get another colour, and draw a bit more. After much whizzing and zipping, an image such as a space shuttle would emerge.

The actual plotting process always drew a big audience. During one peformance I noticed one of Hobart's better known boat builders intently watching this. He'd stare at the plotter, then the computer, and then lean a bit further forward. You could almost hear the little gears turning over in his head. His eyes saw "space shuttle" but the message his brain got was "boat". A good, practical use for a computer. I wonder if he got hooked?

Apple computers seemed to be everywhere at the Hobart show. Well, not everywhere, but concentrated at the two ends of the hall. At one end, old established Apple dealer, Quantum. At the other end, young upstart Apple shop, The Computer Place. And the war was on to attract business to their stands, which mostly consisted of kids. There were banks of Apple IIE s, IIc s, Macintoshes, and the occasional Lisa. There were plenty of games and plenty of chairs. I'll bet the local arcades took a beating that week with all that free competition.

Other manufacturers of small computers had well presented stands, with each attracting devotees of their particular branch of the art. So Atari owners tried out the latest Atari's, Commodore owners tried the Commodores. There didn't seem to be much cross pollination, with most existing computer owners concentrating on the machines they knew.

The stand I was associated with, Flexible Systems, was showing Tasman Turtle Tot robots and a mish-mash of small computers. We had one Apple driving three turtles at once. They danced together in unison, synchronized to music. Another Apple drove the big Elami robot who's turned into a dirty old man of late. He ran around yelling things like "Exterminate", belching loudly, and occasionally pinching girls' bottoms. We also had a talking Commodore 64 that rattled off the time on command or worked as a talking typewriter.

Under Inspection: the Elami robot.

Applied Technology loaned their latest 128K Series 3 Microbee, presumably to show off its icons, two word processors, two spread sheets, three BASICs etc, etc, that all come as part of the package. We dutifully looked at them, and then pulled the system down into CP/M while we figured out how to get the Forth language into it. (No Microbee is safe when there are hackers around, no matter how ▶

Robotic harassment? The Elami robot making its own inspection.

"civilized" it is). With forth installed the big 'bee spent the rest of the show doing robotics experiments, driving speech synthesizers, and writing poetry. One Forth program that proved popular had the prototype for the ETI-677 Chatterbox project (forthcoming) trading insults with a talking Tasman Turtle.

One would expect a lot of competition among rivals at these computer shows but at the Hobart Show it seemed to be just the opposite. One instance came about when a man at the Dick Smith stand wanted to see a modem demonstrated. The modem was eventually fired up using the communications software on the big Microbee at Flexible Systems (next stand to Dick Smith's) and an RS-232 cable from D & I Agencies (across the aisle). We tossed the Dick Smith phone connection over the wall and plugged all the bits together. It all worked nicely, connected through to the Gippsland RCPM. (Yes, Dick, you copped a trunk call. I hope you sold the modem.)

TasBeeb, the BBC Micro users group, featured a large guitar amplifier on their stand, plugged into one of their computers. It played some synthesized Bach for awhile, then some boogie, and finally it cut loose with the theme for the television show *Towards 2000*. All the goodies were the work of a young student with musical talent who had mastered the Beeb's sound generator. Unfortunately the *Towards 2000* programme didn't produce the pictures one normally associates with the music. Pity. Maybe next year? These young computer buffers are doing some amazing things.

There will be a next year, I'm told. The exhibition was organized by brothers Gary and David Adderton, who said this year's effort just broke even. But it proved that they can bring all the pieces together to make a successful show, both for the exhibitors and the public.

— Story and pictures by Tom Moffat

Another PC compatible

The latest news from Warburton Franki is the announcement of Zenith's entrance into the IBM-PC compatible arena.

The new computer system is calld the Z-100 PC Series and is available in both desk top and portable systems.

The Z-100 PC Series is claimed to be totally compatible with the IBM-PC in all four key areas of software/disks, software documentation, expansion/adapter cards and functional compatibility of keyboard.

The desktop model Z-150 PC has extensive memory and storage capacity, 128K memory expandable to 320K and IBM standard format double sided/double density 5¼" floppy disks storing 360K each with optional hard disk providing 10.6MB. Four open IBM compatible slots are available for Z-150 PC expansion and access a wider variety of software programs and peripherals to meet the ever changing needs of business.

Amber or green phosphor monochromatic monitor or the Zenith RGB and composite video display is available, providing the benefits of full colour for business graphics presentations.

For full Z-100 Series specifications contact **Warburton Franki at 7 Birnie Avenue, Lidcombe NSW 2141.**

Data General extends 32-bit computer line

Data General Australia has introduced a series of graphics/engineering workstations and a multi-user office automation system based on a compact, new 32-bit computer. It has also extended its software range with a native UNIX offering and communications capabilities to permit efficient interconnection of the systems in networks .

A company spokesman said its Distributed Systems (DS) 4000 and 4200 engineering workstations incorporate high-resolution monochrome or colour graphics. They are designed for use by individual engineers doing a variety of tasks, such as product design and analysis. The ECLIPSE MV/4000 SC (Small cluster) system extends the range of 32-bit ECLIPSE MV/Family systems. Running Data General's CEO (Comprehensive Electronic Office) office automation software, it can be used by up to eight people. The systems range in price from $A49 000 to $A82 000.

The main software package is called "QuickPlan". With it, "business and engineering managers have at their fingertips an easy to use computer tool that allows them to plan projects and keep them on schedule and within budget" said Peter Quirk, Marketing Manager, Technical Products Division.

QuickPlan permits users to structure time, cost and resource information in a network format, allowing managers to evaluate the cost and resource impact of alternative plans and schedules.

"Through a study commissioned by Data General, we found that roughly one quarter of an engineer's work week is spent in administrative tasks," said Quirk. "QuickPlan will be particularly valuable to engineers and engineering managers who must oversee costly and scarce engineering talent and resources. The study shows project planning software is among the most requested software aids by engineers."

Another of the DS/Family's most important features is communications. Built-in industry-standard Ethernet IEEE 802.3 support allows users to communicate with other Data General 16- and 32-bit systems and non-Data General systems and workstations.

The systems also support Data General CEO (Comprehensive Electronic Office) office automation software to facilitate office tasks such as electronic mail and filing, calendar management and document processing.

For more information contact; **Data General, 26 Ellingworth Parade, Boxhill Vic 3128. (03) 831-3311.**

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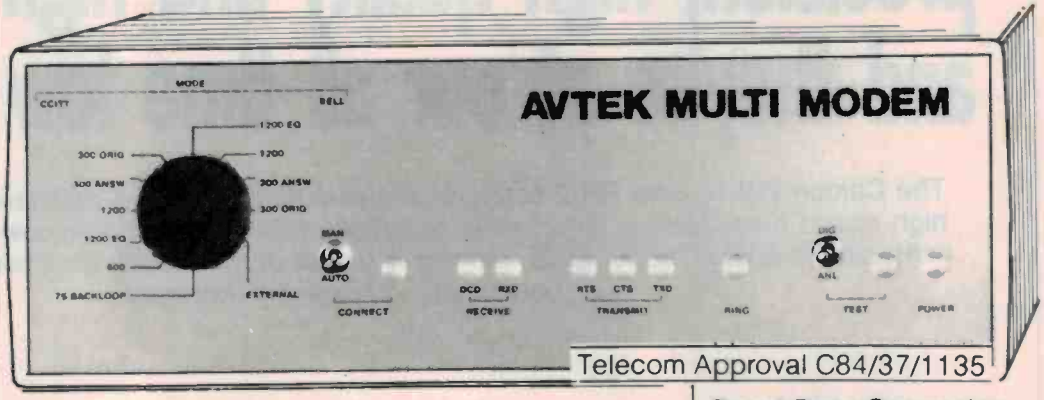

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MODE	RATE	DUPLEX DESCRIPTION
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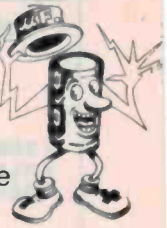

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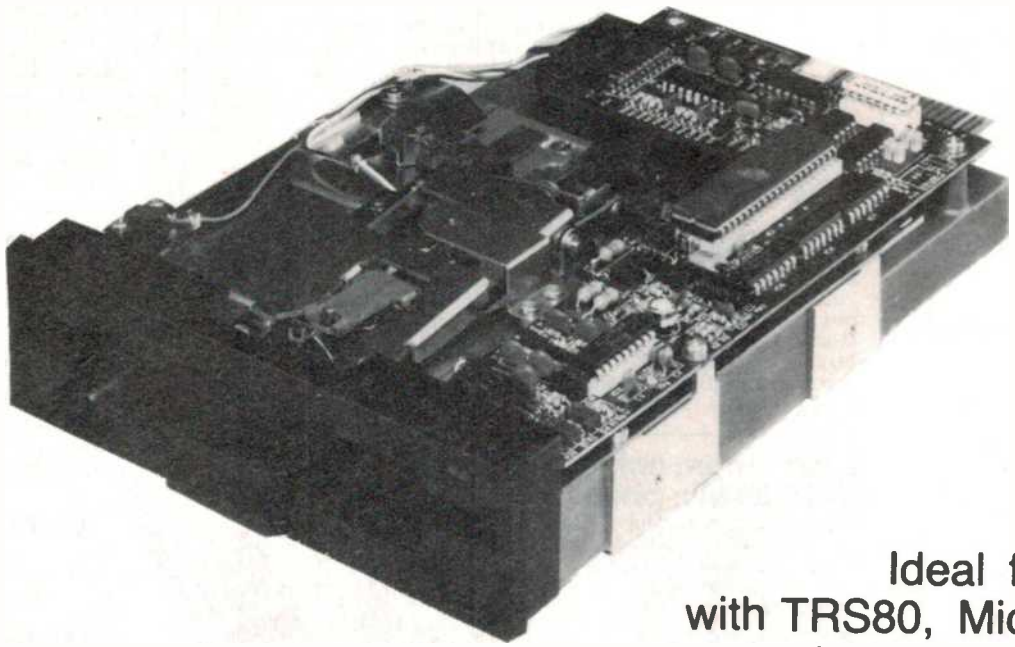

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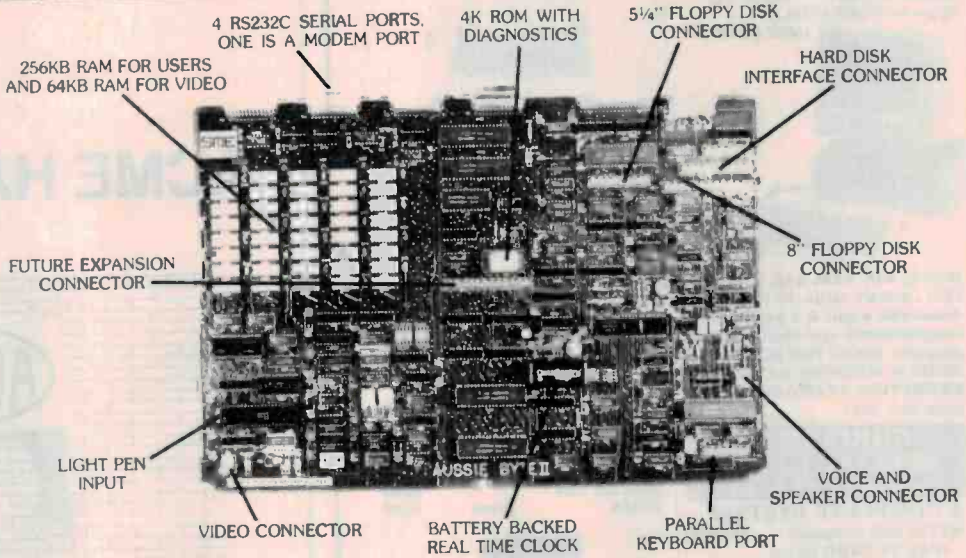
THE AUSSIE BYTE SINGLE BOARD COMPUTER



THE AUSSIE BYTE SINGLE BOARD COMPUTER

AUSSIE BYTE FEATURES

- A fully tested and proven SBC with a 4 MHz Z80A CPU running CP/M Plus (3.0) with 256K of fast dynamic RAM, 4K Monitor BIOS EPROM and DMA capability.
- On-board disk controllers for up to eight 5¼ or 8 inch floppy drives, two hard disk drives, video display and keyboard controller, Hi-res 640 x 608 graphics, four serial RS232C interfaces and one parallel Centronics port.
- Access to BIOS source and operating system software at no charge to any designer. The ultimate in flexibility.
- Optional MP/M supporting up to four users, voice synthesis, S100 or STD bus expansion, future 16 bit support.
- All this on one 30 x 42 cm board minimising cost, complexity and risks.

SPECIFICATIONS

The Aussie Byte board is a complete computer requiring only a power supply, disk drives, keyboard, monitor and cables. No other circuitry is needed to form a complete Z80 based computer.

The Aussie Byte measures 297 by 420 mm. Along its back edge, four 26 way RS232C male connectors are mounted for the serial I/O and a 37 way male connector is provided for connection to a standard Centronics printer. Standard 0.1 by 0.1 pitch upright connectors are provided to connect to 8 and 5¼ inch floppy drives, to a hard disk controller, and for the bus expansion to an S100 or STD bus.

The Aussie Byte directly interfaces to both 8 and 5 inch disk drives connected via flat ribbon cables. Winchester hard disk drives are also supported with the inclusion of a WD-1002 controller and an interface cable. Both floppy and hard disk drives are supported in the CP/M implementation.

For graphics applications, the graphics display controller can be placed in the 630 by 608 pixel high resolution mode. This allows quality graphics to be generated.

Expansion is catered for by the use of a "bus expansion header" connector that provides all the basic Z80 signals. This connector also provides access to the DMA controller, system clock and baud rate generators.

Other features of the Aussie Byte include a programmable tone generator, four serial channels including a modem port, parallel keyboard interface, speech synthesizer, battery backed real time clock.

Power is supplied by means of an 8 way connector. Video information suitable for connection into a monochrome monitor is also available on an external connector. Power requirements are 5V at 3 amps, 12V at 1 amp and -12V at .25 amps.

When power and the required drives, monitor and keyboard are connected, the Aussie Byte will display a message to the screen indicating that it is operating. At this stage the user can press a key to enter the monitor or if left for a few seconds, the internal program will automatically load an operating system from disk. This makes the Aussie Byte particularly easy to start, requiring only switch-on and an operating system disk to be inserted in a disk drive.

The Aussie Byte Z80 CPU has a 4K EPROM monitor program which is used for system diagnostics and for initiating disk based operating systems. The Z80 also has 256K of dynamic RAM which is accessable through bank switching for operating systems that require large address spaces or extra RAM for buffering or cache.

The Aussie Byte has been designed for the greatest possible throughput by the use a full complement of fully interrupt driven Z80 peripheral chips. Another powerful feature is its DMA multiplexer that enables any of the I/O devices to automatically send data to or from memory via the Z80 DMA device by using the ready lines from a selected device to control the DMA channel. This enables data and port transfer to be done in a background mode without processor intervention.

Video display is handled by a 6545 display chip and an 8002 attribute controller. These have their own separate 64K of RAM as well as a 2K CMOS RAM. ASCII characters are generated from an internal lookup table in the attribute controller.

The Aussie Byte is an advanced single board computer with many features, it is easy to implement in dedicated systems and extremely cost-effective.

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PS-AA	450	14.5	50.5	22	2.90
PS-AA	500	14.5	50.5	22	3.30
PS-SC	1200	23.0	43.0	48	4.90
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PS-6200	6	20.0	157x83x125	89.00
PS-1212	12	1.2	100x42x53	24.50
PS-1219	12	1.9	178x34x60	27.50
PS-1226	12	2.6	195x47x70	34.50
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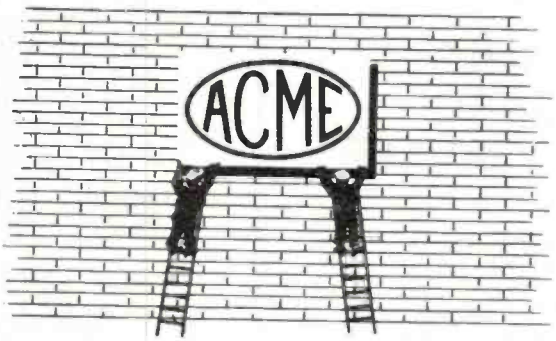

As from 1 October 1984

Acme Electronics

is located at

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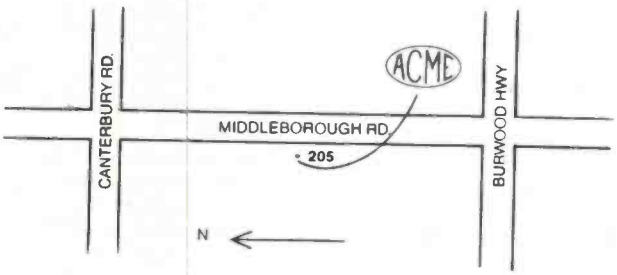

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STR-E-TCH-ED SURFACE DISKS

Collyn Rivers

Advances in magnetic recording techniques have come thick and fast over the past two decades. 'Vertical recording' may still be a thing of the (near) future, but 3M has developed another technique that can be used right now for better performance and cost as well as take advantage of such future developments. In this exclusive report for ETI, Collyn Rivers introduces 3M's 'stretched-surface' recording technology which could see the demise of the hard disk.

ALMOST NINE DECADES have passed since the Danish scientist Valdemar Poulsen invented the first magnetic recording device — the telegraphon — which consisted of a steel wire wound spirally around a cylinder.

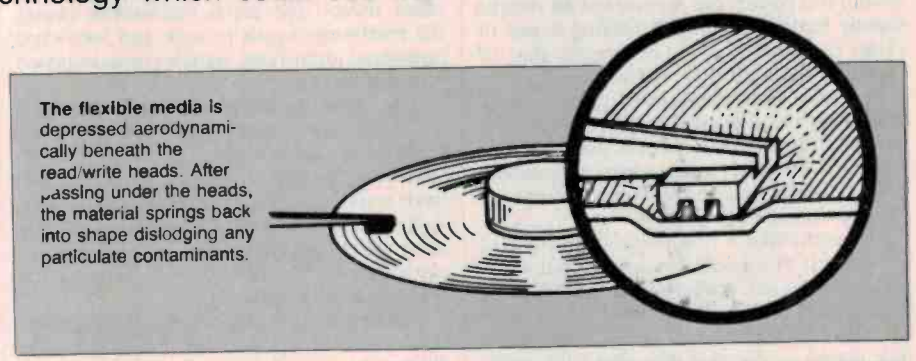
The device, granted US Patent 66 619 on 13 November 1900, was hampered by the lack of electrical amplification and consequently found little practical application.

In 1927 the German inventor, Pfleumer, experimented with a metallic powder coating, and a magnetically coated plastic recording tape was produced in Germany in 1930.

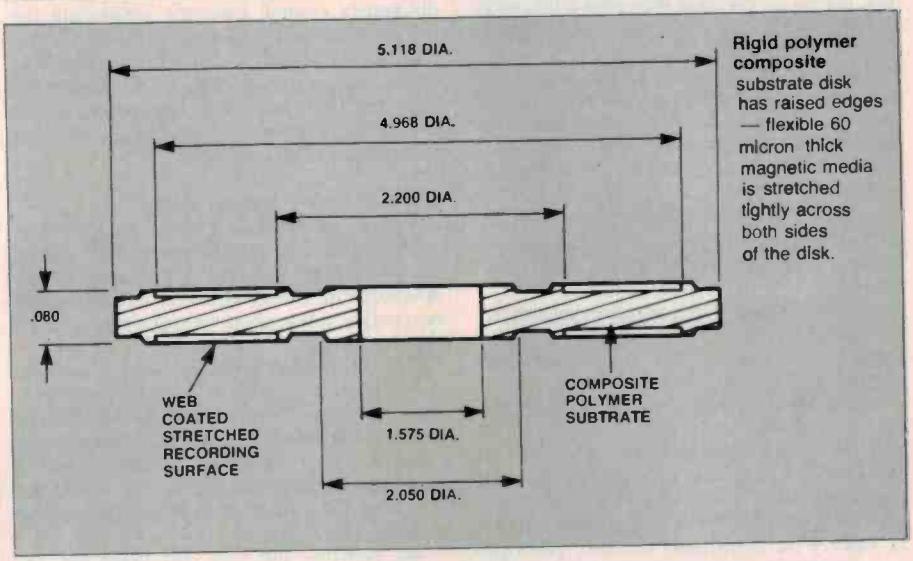
These early experiements concerned the reproduction of sound. Magnetic recording in the computer field uses similar basic principles but with ever-increasing emphasis on the highest possible recording density (and hence data storage capacity) at the lowest possible price.

The results have been dramatically effective, for over the past 10 to 12 years the cost of magnetic data storage has fallen between 40% and 50% each year and if anything the rate of fall is now becoming steeper. The previously common 300 oerstad media (allowing 6000 flux changes per inch) which served the industry for many years is now being replaced by 500-700 oerstad media (allowing 60 000 flux changes per inch). Cobalt modified gamma ferric oxide media are already being used in drives such as Amlyn's 3.2 Mbyte floppy, in Iomega's Bernoulli disk cartridges, and in sub-5-inch diskettes.

Apart from these developments, work is also progressing on 'vertical recording' (where the magnetic molecules are orientated vertically rather than horizontally as at present) a technique which will increase density by at least ten times — possibly more.



The flexible media is depressed aerodynamically beneath the read/write heads. After passing under the heads, the material springs back into shape dislodging any particulate contaminants.



Rigid polymer composite substrate disk has raised edges — flexible 60 micron thick magnetic media is stretched tightly across both sides of the disk.

What is new

Now, the 3M Corporation has introduced a technology which will be able to take advantage of future developments in magnetic media (including vertical recording) but offers dramatic improvements in price and performance right now. The technique, called 'stretched-surface' recording, reliably stores five megabytes on each side of double-sided five and a quarter inch floppies — twenty times that of conventional disks — and will shortly extend that ▶

capacity five or ten times again.

"Stretched-surface technology combines the best characteristics of floppy and hard disks with the disadvantages of neither," says David Clancy, 3M Australia's Data Recording Products Marketing Manager "It's what user's have long sought — hard disk capacity at close to floppy disk prices."

Technically Speaking

3M's technique uses a rigid plastic disk with raised edges — rather like a small and very shallow drum. A flexible media membrane 60 microns thick (the recording surface) is stretched across both faces of the disk, the raised edges of which ensure the flexible membrane is held above the disk's flat surfaces.

As with a conventional hard disk drive, Winchester-type magnetic read/write heads fly just above the surface of the recording media. There the similarity ends for as the disk rotates — at some 3400 rpm — air pressure built up between the head and the membrane causes the membrane to dimple slightly beneath the head leaving a gap of about 5 microns, about a quarter that of conventional hard disk drives.

Because the membrane is stretched tightly across the disk, the continually-moving dimpled area restores itself rapidly, flinging off any loose drop-out-causing debris which may have been present or created during each pass.

"It works like a trampoline" says David Clancy. "It throws off dirt so well that when we showed it at Comdex (Computer Dealer Exposition) earlier this year we ran it with the cover off and had a test rig highlighting disk errors — the rate was about the same as for sealed rigid disk drives — one error every 10 billion bits."

Even repeatedly and deliberately 'landing' the head onto the membrane causes no damage or loss of data — a happening that destroys hard disks first time round. The resilience of the membrane provides the additional benefit that the drive is far less susceptible to impact damage. "We've actually dropped the drive a half inch or so whilst it's running — without damage," says Clancy.

In other tests the drives have successfully completed over 20 000 stops and starts, reading data meanwhile, over a period of 4000 hours.

The magnetic coating itself is non-critical. The unit shown at Comdex utilised a 600 oersted floppy disk coating primarily to demonstrate that the new 3M product is compatible with recent conventional media and drive technology. The coating may just as readily be chromium dioxide, isotropic metal pigments (physical properties are not affected by orientation), barium ferrite, or other materials.

The disks themselves are injection-moulded from a heat-setting plastic resin into which is mixed a special filler. This filler ensures that the disk expands and contracts with temperature at the same rate and by the same amount as do the metal components of the drive itself — thus nullifying the effect of the dimensional changes.

The stretched media membrane too remains dimensionally stable despite changes in temperature and humidity. It also has low 'anistropy' — that is it expands and contracts by similar amounts in all directions, unlike most plastics which stretch and shrink asymmetrically.

These characteristics are essential. The read/write heads must be positioned accurately above tracks which, even in the early prototypes, are spaced a mere 20 thousandth of an inch or so apart. Even minor differences in expansion rate cause the head to be positioned above the wrong track, or if expansion is nonlinear the head may attempt to read several tracks per revolution — with digital chaos resulting.

The servo-controlled head positioning mechanisms used in some drives assist. In one form the basic mechanism is assumed to be sufficiently accurate to place the heads close to the desired track. Once that track has been found, a secondary mechanism continually seeks to position the heads so as to obtain the strongest possible signal from the track — effective with distorted disks which, as a result, rotate elliptically. With other drives, the servo mechanism causes the read/write heads to seek and lock onto positional identifying signals (superimposed on each track).

The first products to use the new stretched film technology will be non-removable disks, with removable disks following closely. These early units will have track densities of 345 tracks per inch — a spacing which may be doubled in later units which are likely to have fixed storage capacities of 48 Mbytes (37 Mbytes for removable disk versions).

Existing drives require only minor modifications to accept the 3M disks. The only obligatory change involves contouring the (manganese-zinc) heads to produce the required aerodynamically-induced dimpling effect, some minor changes to accommodate different data band dimensions, plus a few changes to the electrical levels used for recording and reading data.

Stretching the dollar

Although the technical merits of 3M's new stretched-surface recording (SSR) drives are important, the real significance of the development is that whilst initial tooling will be costly, subsequent manufacturing costs should be low.

The aluminium substrate used in conventional hard disk technology is costly to produce initially. It then has to be heavily nickel-plated and subsequently lapped and polished to a super-fine finish. Even in quantity, these disks cannot be made for less than $5 — necessitating an end price of at least $25.

By contrast the new 3M disks are expected to sell initially for about $5-$10. The price may fall well below that once large volume production is underway. "Injection moulding the disk substrate is the key to the low prices," says Clancy. "The process enables the disks to be produced for 15 to 20 cents each, and the currently used oxide coated membrane adds no more than another two or three cents."

The 3M company has a well developed body of knowledge and experience in various aspects of the new disk technology. The organisation was an early pioneer in the development of magnetic media, and also in the technique of moulding stable plastic disk substrates. They are used by the hundreds of thousands as video disks. The company additionally has its own sources of magnetic oxides.

Hardware manufacturers are currently evaluating the product, and commercial deliveries are expected to start in mid 1985. Already, 3M is publicly demonstrating five and ten megabyte SSR drives using 600 oersted magnetic media.

Rising to the future

Revolutionary though the first 3M SSR products unquestionably are, the next year or two will prove even more exciting in the development of this new range. 3M amongst other companies is actively researching a technique called 'vertical recording' in which the particles forming a disk's magnetic media coating are oriented vertically rather than horizontally. This enables particle density — and hence recording and reading density — to be increased by about one hundred times.

If this technology can be combined with 3M's SSR techniques the way is open for producing plus 100 megabyte drives (probably with removable disks) at much the same price we pay today for a floppy disk drive. And if 3M do succeed in producing such drives, they could," forecasts the authoritative (US) Magnetic Media Information Services, "walk away with the entire hard disk media business in its pocket."

Even in the improbable event that 3M's SSR disk technology remains limited to existing magnetic media, this new development seems almost certain to revolutionise the disk memory business. When they were originally developed (by IBM in 1970) floppy disks were intended as program loaders only — it was not conceived that they would be used for data storage. Their subsequent change of role was brought about by the advent of the home computer — hard disk drives were far too costly, and tape drives too cumbersome and slow. Floppies were seen in a new light and almost instantly found a mass market as on-line storage devices for small computers.

Now, hard disk prices are falling rapidly and in most business systems the floppy disk drive is used primarily as a back-up device. But for reasonable convenience a back-up drive needs to have a capacity of one third to one fifth that of the main drive (with one tenth as an absolute minimum), and it is this reason as much as any, that is causing manufacturers to expand the capacity of their floppy drive products.

In this field, the future for stretched-surface recording drives seems assured, and the devices may well prove a major threat to current hard disk technology if production units have the performance exhibited by pre-production prototypes.

Further details may be obtained from: **David Clancy, 3M Australia Pty Ltd, 950 Pacific Highway, NSW 2073. (02)498-9333.** ●

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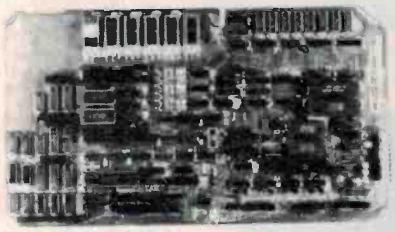

BIG BOARD II

OVER 1,000 SOLD!

Jim Ferguson, designer of the "Big Board" distributed by Digital Research Computers, produced this stunning computer "Big Board II".

FEATURES ...

- **4 MHz Z80 CPU AND PERIPHERALS CHIPS:** The Ferguson computer runs at 4MHz. Its monitor code is lean, uses Mode 2 interrupts, and makes good use of the Z80-A DMA chip.
- **64K RAM + 4K STATIC CRT RAM. 24K (E)PROM OR STATIC RAM:** "Big Board II" has the three memory banks: the first memory bank has eight 4164 RAM's that provide 60K of user space and 4K of monitor space. The second memory bank has two 2K and 8 SRAMs for the memory-mapped CRT display and space for six 2732s or 2K x 8 static RAMS, or pin compatible (E)PROMs, the third memory bank is for RAM or ROM added to the board via the STD bus. Whether bought as a bare board, a full kit, or assembled and tested, it comes with a 450nS2732A EPROM containing the monitor.
- **MULTIPLE DENSITY CONTROLLER FOR SS/DS FLOPPY DISKS:** The "Big Board II" computer has a multiple density disk controller, it can use 1793 or 8877 controller chips. The board has two connectors for disk signal with 34 pins for 5¼" drives, the other with 50 pins for 8" drives.
- **VASTLY IMPROVED CRT DISPLAY:** The "Big Board II" computer uses a 6845S CRT controller and 8002 Video Attributes controller to produce a display that will rival the display of quality terminals. Characters are formed by a 5 x 7 dot matrix on 15.75 KHz monitors and a 7 x 9 dot matrix on 15.75 KHz monitors. The display is user programmable with the default display 24 lines of 80 characters.
- **STD BUS CONNECTOR:** "Big Board II" brings its bus signals to a convenient place on the PC board where users can solder a STD socket, bus cards can be plugged directly into it, and it can as well be connected by bus cable to industry standard card cages.
- **A Z80-A S10/0 = TWO ASYNCHRONOUS/SYNCHRONOUS SERIAL PORTS.**
- **TWO Z80A CTCs = EIGHT PROGRAMMABLE COUNTERS/TIMERS:** The "Big Board II" has two Z80-A CTCs. One is used to clock data into and out of the Z80-A CTCs. One is used to clock data into and out of the Z80-A S10/0, while the other is for systems and application use.
- **PROM PROGRAMMING CIRCUITRY AND SOFTWARE:** The "Big Board" computer has circuitry and drivers for programming 2716s, 2732(Alls. or pin-compatible (E)PROMS. (Software $25 extra).
- **CP/M CAPABILITY:** CP/M with Russell Smith's CBIOS for the "BIG BOARD II" is available (plus tax) $230
  The CBIOS 5" or 8" is avail. seperately (plus tax) $65
  Cat. K41015 NOW $595 (plus tax)

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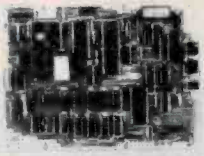

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- 65,536 bytes of RAM.
- Two RS232C I/O ports.
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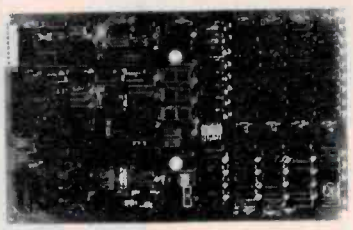

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- **BASIC I/O:** Consists of separate parallel port (Z80 P10) for use with an ASCII encoded Keyboard for input. Output would be on the 80 x 24 Video Display.
- **24 x 80 CHARACTER VIDEO:** With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true. 5 x 7 Matrix, upper and lower case.
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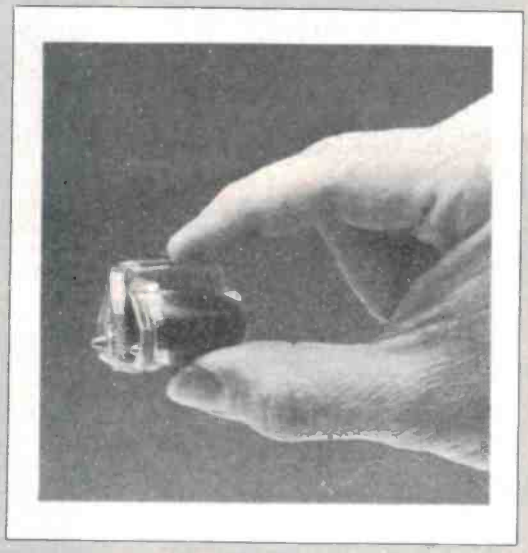
HP-2225A Thinkjet Printer — Report Card

Manufacturer:	Hewlett Packard Inc
Distributor:	Hewlett Packard Australia
Interfaces:	NPIL (IEEE 488) HPIB Centronics
Type:	Inkjet (dot matrix)
Fonts:	Bold (double strike) Expanded Compressed Italic Graphics (bit image)
Speed:	150 characters per second
Footprint (desktop occupied):	290 mm x 205 mm
Paper feed:	Tractor and friction feed
Best feature:	Combination of speed and quietness.
Worst feature:	Restriction on the types of paper it can handle.
Price:	$795
Review unit supplied by:	Hewlett Packard Australia 17-23 Talavera Road, North Ryde NSW 2113
Print matrix:	11 by 12



Above. Printhead capsule. This disposable capsule contains the ink bladder and jets that 'fire' the ink globules at the paper. No hammers, no noise and good for 500 pages! **Top.** Hi-tech, low profile. The Thinkjet is truly tiny — about the size of a small portable typewriter and hundreds of times quieter than a dot matrix or daisywheel printer.

Great graphics! A sample from the Thinkjet printer.

REVIEW

After much bally-hoo Hewlett Packard has finally released its inkjet printer, the HP2225A Thinkjet. Although it is not perfect, it will appeal strongly to both domestic and commercial users.

PRINTING WHILE THE BABY SLEEPS

With Hewlett-Packard's Thinkjet.

These dot matrix utility printers use HP's disposable ink jet printhead

Jon Fairall

INKJET TECHNOLOGY has been around for quite a while in commercial and industrial applications. But the 2225A is the first printer using this technology to be aimed at the home user. It is priced at around about $795, a price which slots it firmly into competition with quality dot matrix printers and with the cheaper daisy wheels.

Hewlett Packard makes three versions of the inkjet, for interfacing to different host computers. There is the HPIB interface for use with the company's 150 and other computers. This is actually HP's implementation of the IEE 4888 standard. The HPIL interface is also available on the Thinkjet. This is a looped data stream especially designed for handheld calculators and small computers. HP have also provided a centronics interface for parallel working with other manufacturer's equipment.

How it works

The operation is deceptively simple: marks are made on paper by squirting ink at it. In Hewlett Packard's application, this is achieved by a small disposable cartridge that contains an ink bladder, a column of microscopic pipes and heater elements. The bladder is made of rubber and exerts a pressure on the ink inside it. As the ink is used-up the bladder collapses, maintaining a constant pressure on the ink. This pressure, and capillary action, suck the ink into the small pipes. When an instruction comes from the host computer to fire the ink, a heater element wrapped around the pipe is switched on. Virtually instantaneously, the ink in the pipe vapourises, forming a bubble that expands rapidly. The expanding bubble shoots ink out the open end onto the paper. As the bubble contracts fresh ink is sucked into the pipe and the cycle can be recommenced as desired.

All of this is contained on a disposable cartridge. In spite of the tiny electrical connections that need to be made (between the heater elements) it is surprisingly easy to replace. It just drops into a slot in the carridge and is then secured by a large latch. Beyond keeping it clean there is really nothing to check or maintain on the cartridge. If it runs out you buy another. The price is about $13, with a discount for buying in bulk. According to HP, each cartridge will print about 500 pages of text. Obviously this varies with the application. Graphics take more, a typical letter or memo which does not use the whole page will take less.

Intuitively, it is surprising that the system works with any degree of certainty, but experience shows that not only does it work, it works extremely well. Each dot sprays a small area considerably less than half a millimetre in diameter. Viewed with a magnifying glass each dot is surprisingly regular and clearly defined. One would expect to see splatters of ink running in all directions, but this does not happen. We can only speculate at the amount of research that must have gone into getting the right combination of exhaust velocity, spray angle and cartridge-to-paper distance to achieve this.

Of course, the paper onto which you are printing does make some difference to the equation. As a general rule the more absorbent it is the better. HP make a special paper which they recommend, but it's not necessary to go to those lengths to get satisfactory results. In our tests we discovered that the Thinkjet works like a charm with standard 240 mm fan folded paper, but the print quality noticeably deteriorated when we tried to use high quality bond paper. Viewed through a magnifying lens it was apparent that the shape or consistency of the dots had not changed. What appeared to happen was that there was a slight vertical smearing effect, presumably caused by the rapid movement of the head during line feed. There is an absorbent pad on the front of the carriage which touches the paper, and this seems to be the culprit.

Print quality

Given the ability to make small regular dots in this way, the inkjet has one terrific advantage over other forms of impact matrix printer: it is possible to pack a lot more dots into a given area. In an impact printer ▶

you have to pack the firing mechanism for all the pins into the head. In an inkjet, you only need space for a heater element. Since the amount of ink that needs to be heated is extremely small the element can be made tiny as well. Add to this the fact that in the impact printer the size of the dot is only slightly bigger than the needle used to hit the ink ribbon. But with an inkjet it is possible to make the dot considerably bigger simply by the design of the nozzle. This leads to a considerable amount of overlap between the dots, with the result that the printing doesn't have the discontinuous "dotty" look of a conventional matrix printer.

It would be a mistake however, to think that the Thinkjet creates letter quality printing, in the sense of a daisywheel printer or a typewriter. Even a cursory glance will show the difference. But that is not to say that the Thinkjet is not acceptable in this role. It's print is very pleasing on the eye, and certainly doesn't look cheap and nasty.

Advantages

It also has all the traditional advantages of a dot matrix printer over a font printer like a daisywheel or a golfball. The typesize, characters per line and lines per centimetre can all be varied in the usual fashion under software control. There is a choice of typeface as well: bold, condensed and expanded. Once again, it is not necessary to go to the trouble of changing daisywheels or golfballs, it's all available through escape codes.

There is also, as one would expect, a graphics mode with default dot density of 96 dots to the inch in both the vertical and horizontal direction. This can be increased to 182 dots in the horizontal direction, but it's not possible to increase the vertical resolution. Graphics data is sent to the printer one byte at a time in groups, where each group contains the graphics data for one horizontal row of dots.

Another aspect of the Thinkjet that particularly pleased me was the physical design of the unit. For a start, it's unbelievably small, with a 'footprint' only 290mm by 205mm. That would probably make it the smallest printer capable of taking A4 or 240mm fan folded paper.

It is also exceptionally fast. HP claim a speed of 150 characters per second. It is bi-directional as well i.e: it prints one line left-to-right and the next one right-to-left, thus eliminating the time necessary for a carriage return. As a result the effective throughput of the Thinkjet is very close to what one would expect from these figures, unlike the conventional printer that only prints in one direction. Typically one finds that the time taken to move the print head from the end of one line to the beginning of the next can amount to thirty percent of the time taken to print a document, making speed claims very deceptive.

The paper loading system is also exceptionally simple. There is none of the messing about you normally expect. To load paper, you simply push it into the slot. Surprise, surprise, it actually goes in quite easily, and comes up where it should. I wasn't able to sort out what the HP designers have done to the paper feed to make it so pleasant to use — it looks just like my xx-80, but believe me, it doesn't act that way. It may have something to do with the fact that there isn't a platen on the 2225, just a couple of rollers. The paper is held by the pressure of the pinch bar on top of the paper squeezing down on these rollers. This arrangement is possible of course, because there is no impact mechanism.

The fact that there is no impact mechanism is also responsible for the 2225A's best single quality. It is quiet! In fact it's rather disconcerting, when you first use it, to find that in an office like ours, with a fair amount of noise around, (air conditioning, assorted yells and shrieks as yet another deadlines goes past, that sort of thing) it's impossible to tell whether the unit is going until the paper starts issuing forth.

Summary

In summary then, the HP2225A is a superb little printer, well worth considering if you want to spend $800 or so on a new one. It's fast, quiet and easy to use and offers superb print quality. It's only limitation is that it can't be used on high quality paper. ●

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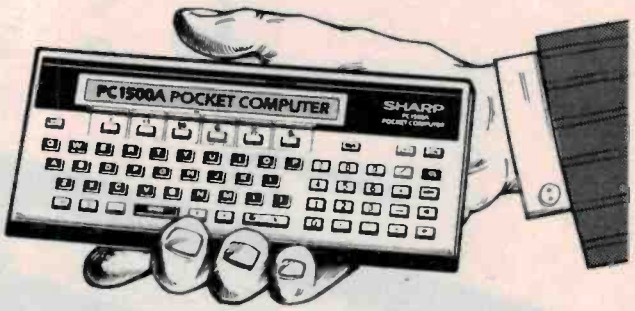

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LOW RESOLUTION JOYSTICK DRAWER

M. McLaren, Labrador Qld.

This program allows you to use the joystick or keys to draw in LORES.

If you need to use the keys use 'W' for up, 'Z' for down, 'A' for left and 'S' for right. You can rubout using the fire button on the joystick or the 'P' key.

```
00100 REM Joystick or Keyboard Drawing
00110 REM By J. McLaren of Gold Coast MicroBee Users Group
00120 CLS:POKE 257,1
00130 CURS 28:PRINT"Joy-Draw"
00140 PRINT"This program enables you to draw in Low Resolution with the"\"joysti
ck or the following keys 'W' up, 'Z' down, 'A' left and"\"'S' right."
00150 PRINT\"You can also rub out a single space by pressing the 'FIRE'"\"button
 or the 'P' key. You can also hold the 'FIRE' button"\"down and move around cont
inually rubbing out."
00160 PRINT\"You start in the centre of the screen."
00170 LORES
00180 X=61:Y=22
00190 PRINT:INPUT"Do you want to use the Joystick or Keyboard 'J' OR 'K'?";J1$:C
LS:IF J1$="K"THEN 320
00200 CLS
00210 REM
00220 OUT 1,255
00230 A=IN(0)
00240 A=143-(A AND 143)
00250 B=-(A AND 1):IF B THEN GOSUB 400
00260 B=-(A AND 2):IF B THEN GOSUB 410
00270 B=-(A AND 4):IF B THEN GOSUB 420
00280 B=-(A AND 8):IF B THEN GOSUB 430
00290 B=-(A AND 128):IF B THEN GOSUB 390
00300 B=-(A AND 512):IF B THEN GOSUB 440
00310 GOTO 230
00320 K1$=KEY$:IF K1$="" THEN 320
00330 IF K1$="W" THEN GOSUB 400
00340 IF K1$="Z" THEN GOSUB 410
00350 IF K1$="A" THEN GOSUB 420
00360 IF K1$="S" THEN GOSUB 430
00370 IF K1$="P" THEN GOSUB 390
00380 GOTO 320
00390 GOTO 440
00400 Y=Y+1:SET X,Y:RETURN
00410 Y=Y-1:SET X,Y:RETURN
00420 X=X-1:SET X,Y:RETURN
00430 X=X+1:SET X,Y:RETURN
00440 RESET X,Y:RETURN
00450 END
```

BEETLE BASHER

Peter Easdown, Kew NSW

Beetle Basher is similar to games in which you must steer a car back and forth along a road.

The difference here is that you steer a beetle, not a car.

The story is that the beetle has found a pile of tyres over his home. You must direct him to his home at the bottom. Sounds easy? It's not. There happens to be a breeze blowing, and the pile of tyres has a bad habit of swaying, thus making life for the beetle very hard. The tyres are a support for a sticky, parasitic mould. Guess what would happen if the beetle got stuck on that stuff.

What else could happen? Well, in piles of tyres, spiders have a habit of nesting, so once you get the beetle down a bit you start coming across spiders in your way. Quick, dodge, or you know what will happen!

```
00010 W=0:FORK=64528TO64623:'READA: POKEK,A: NEXTK
00020 RESTORE 220: FORK=64000TO64015: READA: POKEK,A: NEXTK
00030C=0:M=0:GOSUB480:GOSUB370:NORMAL:CURSX,Y-1:PRINT"    ";:PCG
00040X=30:Y=8:PCG
00050E=28:G=1:F=34:GOTO70
00070CURSX,Y:PRINT"ABC":CURSX,Y+1:PRINT"DEF":A1$=KEY$
00080A=X:B=Y:IFA1$=","THENLETC=-1
00090IFA1$="."THENLETC=1
00100CURS1,1:PRINTM:M=M+1
00105IFM>200THENGOSUB310
00110X=X+C
00120Q=Y-1:IF PEEK(61440+(Q*64)+X-1)=160 THEN350
00121IF PEEK(61440+(Q*64)+X)=160 THEN350
00122IF PEEK(61440+(Q*64)+X+1)=160 THEN350
00123Q=Y:IF PEEK(61440+(Q*64)+X-1)=160 THEN350
00124IF PEEK(61440+(Q*64)+X)=160 THEN350
00125IF PEEK(61440+(Q*64)+X+1)=160 THEN350
00140NORMAL:CURSA,B:PRINT"    ":CURSA,B+1:PRINT"    ";:PCG
00150GOSUB300:GOTO70
00160 DATA 0,0,0,0,0,0,0,0,9,5,2,3,10,6,2,10,9
00170 DATA 0,0,0,0,0,0,120,206,169,19,17,16,16,16,16,144,17
00180 DATA 0,0,0,0,0,64,128,128,0,0,160,192,128,160,160,64
00190 DATA 6,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
00200 DATA 214,186,130,198,238,124,130,130,68,0,0,0,0,0,0,0
00210 DATA 128,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
00220 DATA 85,170,85,170,85,170,85,170,85,170,85,170,85,170,85,170
00230Z=INT(RND*2)+1:RETURN
00240IFZ=1THENLETE=E-1:F=F-1
00250IFZ=2THENLETE=E+1:F=F+1
00260IFE<15THENLETE=15:F=22
00270IFF>50THENLETF=50:E=44
00280N=INT(RND*3):IFN=0THEN230
00290RETURN
00300CURS1,16:PRINT SPC(E-3):CURSF+3,16:PRINT SPC(63-(F+3)):PRINT:GOTO240
00310Q=INT(RND*15)+1:IFQ<>2THENRETURN
00320Q=INT(RND*8)+1:CURSE-3+Q,16:PRINTCHR$(32);:RETURN
00350GOSUB570:CLS:NORMAL:PRINT"You let the beetle get eaten  by the sticky mould,
   but you     managed to get him about ";M;" cm towards his home."
00360IFM>WTHENLETW=M:INPUT"YOU GOT THE HIGH SCORE, WHAT'S YOUR NAME ";N1$:GOTO30
ELSEFORK=1TO2000:NEXTK:GOTO30
00370RETURN:PLAY6,2,11,3,6,2,11,5,0,2,6,2,11,3,6,2,11,5,0,2
00380PLAY 6,1,0,1,6,1,0,1,6,1,0,1
00390PLAY 15,1,0,1,15,1,0,1,15,1,0,1
00400PLAY 11,1,0,1,11,1,0,1,11,1,0,1
00410PLAY 6,1,0,1,6,1,0,1,6,1,0,1
00420PLAY3,5,0,2
00430PLAY 6,1,0,1,6,1,0,1,6,1,0,1
00440PLAY 15,1,0,1,15,1,0,1,15,1,0,1
00450PLAY 11,1,0,1,11,1,0,1,11,1,0,1
00460PLAY 3,1,0,1,3,1,0,1,3,1,0,1
00470PLAY11,5:RETURN
00480CLS:NORMAL:CURS25,2:PRINT"BETTLE BASHER"
00490NORMAL:CURS1,4:PRINT"Get the beetle home down the pile of tyres      and do
dge the   walls. Use the '<' and '>' keys to move the beetle sideways."
00495IFW<>0THENCURS1,6:PRINT"HI SCORE BY "N1$:" = ";W
00500CURS1,8:INPUT"Hit  'RETURN' to start the game.... ";A1$:PCG
00505CLS
00510E=28:G=1:F=34:FORZ=1TO15:CURS1,Z:PRINT [A28 32]:CURS34,Z:PRINT [A31 32];:NE
XTZ:W=E:I=F
00515CURS1,1:PRINT [A128 32]:X=30:Y=1
00520CURS21,1:PRINT [A21 160];:CURS21,2:PRINT [A21 160]
00530CURS21,3:PRINT [A3 160];:CURS39,3:PRINT [A3 160];
00540CURSX,Y:PRINT"ABC":CURSX,Y+1:PRINT"DEF":Z=Y:Y=Y+1
00550IFY=8THENRETURN
00560FORK=1TO200:NEXTK:PLAYZ,1:CURSX,Z:NORMAL:PRINT"    ":PCG:GOTO540
00570FORK=1TO10:CURSX,Y:PRINT"XXX":CURSX,Y+1:PRINT"XXX":FORZ=1TO30:NEXTZ:PLAYK,1
00580CURSX,Y:PRINT"ABC":CURSX,Y+1:PRINT"DEF":FORZ=1TO30:NEXTZ:PLAY 11-K,1:NEXTK:
RETURN
```

MICROBEE NUMBER FORMATTING

Peter Lukes, Toowoomba Qld.

The MicroWorld BASIC number formatting function is useful for aligning columns of figures, but lacks the facility for presenting the figures in the format used in financial statements. This short routine can overcome this disadvantage.

The number is printed in a certain position in the screen in the (F16.2 n1) format. A loop is used to transfer the digits from the screen memory to a string, inserting the thousands separators at the same time. The string is then processed into two forms. The first form fills the leading blanks with asterisks and places a dollar sign immediately before the first digit, and the sign of the number is printed after the last decimal place (this could be replaced by DR or CR). The second form encloses a negative number in brackets. Whole numbers could be produced by not including the decimal point and places in the string.

The routine is fairly slow but it can be speeded up, and memory saved, by compressing it. The formatted number can be printed anywhere on the screen where it will not interfere with the existing display or produce a scroll, and erased by printing spaces over it.

```
Enter number, up to 14 significant digits : 123456789012.34
 123456789012.34
*$123,456,789,012.34+
  123,456,789,012.34
Enter number, up to 14 significant digits : -123456789012.34
-123456789012.34
*$123,456,789,012.34-
 (123,456,789,012.34)
Enter number, up to 14 significant digits : 0
           0.00
*****************$0.00
                0.00
Enter number, up to 14 significant digits : 9e11
 900000000000.00
*$900,000,000,000.00+
  900,000,000,000.00
Enter number, up to 14 significant digits : 9e12
****************
Field overflow
Enter number, up to 14 significant digits : .01
           0.01
*****************$0.01+
                0.01
Enter number, up to 14 significant digits : 999999999999.99
 999999999999.99
*$999,999,999,999.99+
  999,999,999,999.99
Enter number, up to 14 significant digits : -999999999999.99
-999999999999.99
*$999,999,999,999.99-
 (999,999,999,999.99)
```

```
00100 cls:Print "Microbee Number Formatting Lks 840212"
00110 sd 14:rem Set significant digits
00120 L0$="****************$":rem Leading filler
00130 P=132:S=61440+P:rem P=print Position,S=screen
      Position
00140 curs 64:Print spc(255) spc(255):curs 64:rem Clear
      screen
00150 input "Enter number, up to 14 significant digits :
      " N1
00160 curs P:Print USING F16.2 N1:rem Print formatted number
00170 R1$="":for A=1 to 16:K=Peek(S+A):if K<46 then 200
00180 R1$=R1$+chr$(K)
00190 if flt(A/3)=flt(A)/3 and A<16 then let R1$=R1$+","
00200 nextA:rem Assemble digits and separators into
      string
00210 if R1$="" then input "Field overflow" R1$:goto 140
00220 R2$=L0$+R1$:L=len(R1):if N1=0 then let R2$=R2$+" "
00230 if N1<0 then let R2$=R2$+"-":R1$="("+R1$+")":L=L+1
      :rem Neg
00240 if N1>0 then let R2$=R2$+"+":rem Pos
00250 Print R2$(:len(R2)-20)
00260 Print spc(20-L) R1$:input R1$:goto 140
```

Microbee users in Townsville will be interested to know that their local users' group is now meeting on the ground floor of St. Margaret Mary's Secondary School, Crowle Street, Hermit Bay on the second and fourth Sunday of each month. Meetings commence at 7.30 pm. The president in Peter Foster (077)72-2951 and the Secretary is Mannie van Rijswijk (077)73-4236.

MINI-MART For Sale/Wanted/ Swap/Join

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FOR SALE: JVC MCA VSE, quality amp, 100 W, going order, $100 or offer. Ian McLean (02)818-1818.

WANTED: TECHNICAL INFORMATION for rebuilding Philips F8Z18A concerto stereogram. Rout, 3/137 Champion St, Christchurch NZ. Ph. 79-7882.

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FOR SALE: SONY WALKMAN DD, including; Sony MDR-W5 Dynamic Stereo Headphones, Case, Strap, and Manual. Excellent sound reproduction quality, good condition. $80. B. R. Munro, 14 Elm Road, Campbelltown, SA 5074. (08)337-4514.

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FOR SALE: SIEMENS model 100 teletypes as ETI Oct '84 $65 plus delivery, F. Rees, 27 King St, Boort Vic 3537.

FOR SALE: PHILIPS FM 320 UHF CB and 10 foot high gain Fleury co-linear $280. (062)86-2475.

COMPUTERS

WANTED: CIRCUIT or service manuals for Imark Pocket Scanner model DS103. Ph R. A. Masterton (02)605-2487.

FOR SALE: MICROBEE Hyperspace (Keyboard or joystick) and Bonus Grand Prix. Only $5 for tape and listing. T. B. Knowler, 5 Keane Place, Fraser ACT 2615.

WANTED: Apple 2+ required by by student without software. Must be going. P.O. Box 5915 Rockhampton MC, Queensland 4700.

FOR SALE: URGENT: MCE enhancement board for Super 80 computer. Graphics of 560 x 225 and 256 graphics characters. $99.50 with documentation. Jeremy Ellis (03)459-5698.

WANTED: CONTACT with other Microbee users or club that caters for same in North Brisbane area. Contact Michael French, 76 Barrett St, Bracken Ridge. (07)269-8405.

FOR SALE: SWPT S550 computer system, two RS232 ports, centronix port, 40k RAM spare CPU, FDC and cable. Flex 2 DOS. $425 R. Steedman RMB 9010 Lucknow Vic 3875. Ph (051)56-8291.

FOR SALE: ATARI 2600, 2 joysticks, paddles 26 cartridges case and drawer. Good condition $500 ono. (02)520-7237.

WANTED: TRS80 EXPANSION Interface with two disk drives plus business software. Your price. Les Kinch, Longford, Bendemeer NSW 2352.

FOR SALE: SHARP PC15600 plus printer, 8k module, all manuals and Sharp technical manual. Software. Bargain at $600. Kevin (02)642-4093.

FOR SALE: FLOPPY DISKS: Professional-quality SSDD 5¼" diskettes. $24/box of 10, postage $2/box. Phone Peter (02) 349-6319, P.O. Box 448, Marboubra, NSW 2035.

FOR SALE: TANDY MC-10 colour computer $70. Computer classics 300 CT modem $225. Commodore 64 and 1541 drive $725 ono. Ben Begg (08)31-0310.

FOR SALE: SORCERER 58k VDU stringy floppy, Devpac software. $350. A. H. Herp, 11 Vernon Ave., Gorokan NSW 2263. (043)92-1611.

FOR SALE: ATARI 800, 48k RAM 810 disk drive, printer and all accessories with $600 worth of software and books. $1700 ono. (03)763-0787.

FOR SALE: VZ 200 Extra listable commands. Auto, Trace, Delete, On goto, Onerror, String$, Defdbl, etc. Cassette and information. $10-$15 G. Lehmann, 6 Midway Rd, Elizabeth East SA 5112.

WANTED: Exidy FDS Disk Drive for Sorcerer Computer or S100 Expansion Unit. Ph. (02)452-4014.

FOR SALE: MICROBEE 32+ with 4MHz mod., EDASM, Kaga Denshi green monitor, joystick, chess, $550, K. Lau. (02)498-7270.

FOR SALE: EPROMS AND RAMS: 2708 and 2716 EPROMs $5 and $8, clean ready to program. 16K dynamic RAM (4116) assorted makes $2 a piece. (047)59-1721 a.h.

FOR SALE: APPLE TWO EUROPLUS, 64 K RAM, Disk Drive, green screen monitor, 80 column card, serial card, printer, 90 diskettes, excellent condition, $2500. B. R. Munro, 14 Elm Road, Campbelltown, SA 5074. (08)337-4514.

RESEARCH MACHINES 380Z computer, 48K RAM, three RS232 ports, four 8in. DS/SD BASF floppy drives, Okidata 110 printer, two cassette drives with controller, Votrax speech synthesiser, Dataphone 300 baud direct modem, extensive CP/M software, cost $10K, sell $4K. Frank, (051)55-9232.

MISCELLANEOUS

FOR SALE: Model railway, 1.8 by 2.5 metres, 25 cm deep. Can be stored vertical, or has a tabletop cover, 17 electrically driven points and 13 signals, with station indicators. Nine complete trains, modern to 25 yrs old, cat power over ½ layout, all stations and buildings lit, ETI electronic controller. 24 manhours of professional after-sales service, $1200 the lot. Jonathan (02)692-2962 (10-2), (02)419-2962 (a.h.).

WANTED: OSCILLOSCOPE 125mm, 10MHz 1μs timebase minimum requirement. Pay up to $250 depending on features and condition. M. White, 19 Lawley Cres, South Hobart, Tas 7000. Ph (002) 235-5340.

FOR SALE: Moray Fuel Sensor $25, Moray Speed Sensor $15, Realistic 6 spkr. P. A. Column $90/pr., Realistic Minimus 11 Bookshelf Spkr. $90/pr. All Brand New. Ron Coleman. Ph. (062)88-5369.

SHOP AROUND

NOTES & ERRATA

ETI-278 Directional door minder, Nov. '84. The overlay and wiring diagram on page 70 contains an error in the caption at the top left corner. The sentence "make sure the green (neutral) mains lead is the longest." should read as follows: "make sure the green/yellow striped earth wire is the longest."

ETI-683 Mindmaster

The components for this project are readily available from most electronics retailers. If you're after a kit, try *Altronics* in Perth, *Jaycar* in Sydney, *All Electronic Components* and *Rod Irving* in Melbourne and perhaps your local *Dick Smith* store. Ready-made pc boards and, in some cases, Scotchcal panels, may be obtained from the suppliers listed on page 144 of the October issue.

ETI-1422 Column speakers

The 6" speakers used in our prototypes were obtained from *Jaycar* in Sydney, type H16CP60-02C. They're only a few bucks and just right for the job. If you use twin-cones in the large column, as suggested, they're the ones used in the '463 Masterplay speakers (Oct. issue): Pioneer C16EC70-01FW, also from *Jaycar*. Note that *Altronics* may be able to supply them, also.

ETI-741 Radio mic.

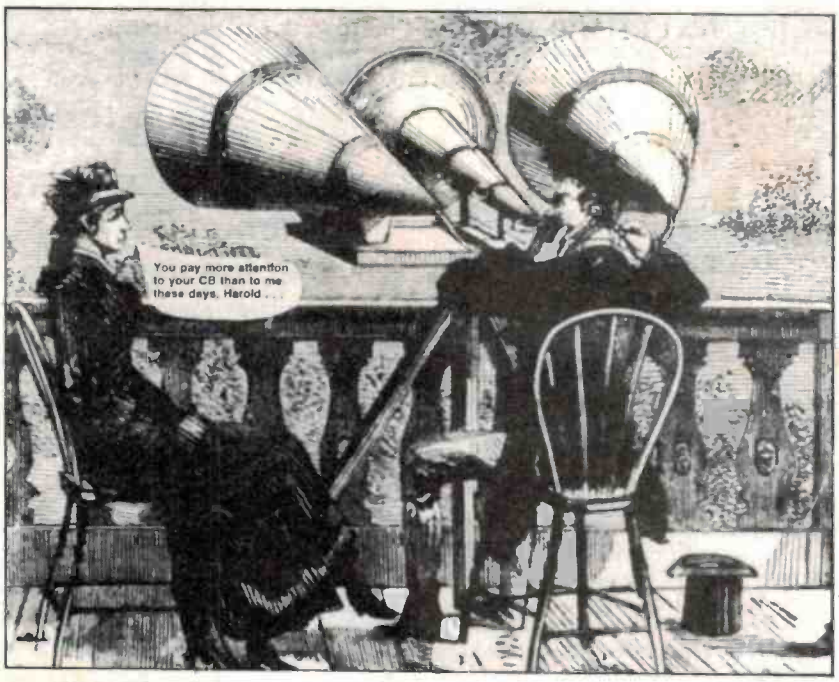
You'll have to shop around for parts for this project. However, *Geoff Wood Electronics* in Rozelle, Sydney has indcated he'll be getting parts in for this project. The Neosid K6 coil assembly is distributed by *Neosid, 23 Percival St, Lilyfield, Sydney NSW*. The Motorola ICs are obtainable from a number of suppliers — but they may have to be ordered in. The Intersil reference zener (IC4 — ICL8069) is imported and distributed by R&D Electronics and may be obtained through *All Electronic Components* in Melbourne and *Geoff Wood* in Sydney. We might have more information for you next month.

Artwork

Making your own pc boards? Full-size positive or negative film is available for the prices listed below. Send requests, with payment, to: *ETI-xxx Artwork, ETI magazine, PO Box 227, Waterloo NSW 2017*. Make sure you specify positives or negatives, according to the process you use. Make cheques or money orders payable to 'ETI Artwork Sales'. Here are the prices for this month's projects.

ETI-683: pcbs — $2.50; panels — $4.40
ETI-741: pcb (double-sided) — $2.20
ETI-755: pcbs — $5.40; panels — $5.95 ●

DREGS



YOUR DREGS COLUMN this month comes to you from poolside Tamworth, capital of country New South Wales. Now what, you may ask, is going on in Tamworth to lure your correspondent away from his daily carbon monoxide fix? Well, not a hell of a lot actually, not a hell of a lot. Sloth is the order of the day.

But all is not completely quiet up in the bush. Not by a long shot. Over in Lismore there is a company called Hi Tech Control Systems that is setting the world on fire with a device that is the answer to many a cocky's prayers. It's called an Electronic Scarecrow, and Hi Tech insists this is the final solution to the problem of crop damage due to pest infestation.

According to one of the innumerable press releases that came over the Dregs desk this week, the Electronic Scarecrow will completely protect a crop from all types of predators. Field trials in the Lismore area stopped an influx of flying foxes from attacking the bananas, but it can be used against virtually any form of predator, including something as big as a kangaroo. The system needs to be custom-tuned for each individual location, so it will protect a clearly defined area, like an individual field or orchard.

Well, a story like this needs following up. How, when, where, why, how much; all the usual questions we like answered so we can be bigger and brighter than the opposition. The boss cocky in the scarecrow business is a gent by the name of Ron Fry. According to Ron, the Electronic Scarecrow works on sound pressure waves. It can throw a beam half an inch wide, six foot high and twelve kilometres long. When a fruit bat (or whatever) runs into this beam, the pressure waves interact with the bat's skeletal structure and cause an experience much like being hit on the funny bone. The bat loses the ability to fly and drops like a brick. As soon as it leaves the beam it recovers and flies off into the distance; a surprised and somewhat wiser little bat.

A leg-pulling device?

Now, Dregs is not cynical. Here at ETI we pride ourselves on our gee-whiz attitude to high tech. But this is a little strange. A sound wave half an inch wide and twelve kilometres long? Who's pulling whose leg around here? Not the Department of Agriculture anyway. They gave $200,000 to develop the Electronic Scarecrow. According to Hi Tech they're investigating using them in the third world, and apparently the Yanks are hot to trot as well. There has been "aggressive interest" from certain quarters in the US, according to Mr Fry.

In fact, there are so many people who want to know how the thing works that Hi Tech has decided not to patent the idea, but to use rather more extreme methods to protect its invention. The Electronic Scarecrow comes complete with a self-destructing circuit board — if you open the box that's it. Fans of Mission Impossible will get the idea.

Well, how does it work? Mr Fry is not telling. It's not an ultrasonic device, he says. It works on sound pressure waves. He won't say what frequency it works at, or what the transducers do. He won't say how the self-destruct mechanism works. In fact, Mr Fry is not the most forthcoming of men. Still, you can see his point. If I had a device that could apparently violate as many physical laws as Ron's can, I wouldn't tell you how it worked either.

But we can speculate. It's not ultrasonic and it's not within the audio region, so that leaves infrasonic waves. (Mr Fry assured me that the device has no effect on humans, so it must be outside the range of human hearing.) Infrasonics have a small number of applications, none of them particularly pleasant. In countries with even worse politicians than ours, infrasonics are used as a method of riot control. Apparently a sound-wave propagating at around 5 Hz affects the middle ear, causing giddiness and nausea. Could the Electronic Scarecrow work along these lines?

Well, the biggest objection I can see straight away is a power one. To project an infrasonic wave 12 km we would need access to the entire generating capacity of the NSW Electricity Commission. Of course, Ron wouldn't be the first businessman to exaggerate the capabilities of his product, but even if he was out by a factor of 10, you still need to project changes 1.2 km down the track, and you still need to build a small power station every time you want to set up a scarecrow. Easier to simply burn the coal and poison the little beggars with acid rain, surely?

How could one get around the power requirement? One method that might go part of the way towards a solution, and also account for the directionality of the system, might be some sort of phased interferometric system. If one had a number of transducers all broadcasting with some specified phase relationship, there would be regions where, as the waves propagated outwards, they would sum to a maximum, and other regions where they would subtract to zero. Presumably one would end up with a distribution pattern in which there was a single central beam of high intensity corresponding to the fundamental harmonic, with side lobes of lesser power. The problem with a system like this is that the wavelength is so long at these frequencies one would assume mutual interference effects would be smeared out so that they would have no effect at all. In any event it's difficult to see why a beam like this would have the effect Mr Fry claims.

Well, if infrasonics won't work, what about ultrasonics? If we forget about the power problems (which are still formidable, but not as bad as with infrasonics), it at least becomes possible to see why flying foxes might stay away. The foxes can hear ultrasonic frequencies, so they might find the scarecrows incredibly noisy. Of course that's a long way from Ron's claims, but we are clutching at straws here.

Dregs retires from the field, bloody and exhausted. How has he done it? I'm sure the whole idea violates all the normal laws of physics. Next month I'll show you how to move faster than light. In the meantime, if any of you can imagine how such a beam might work, let us know. ●

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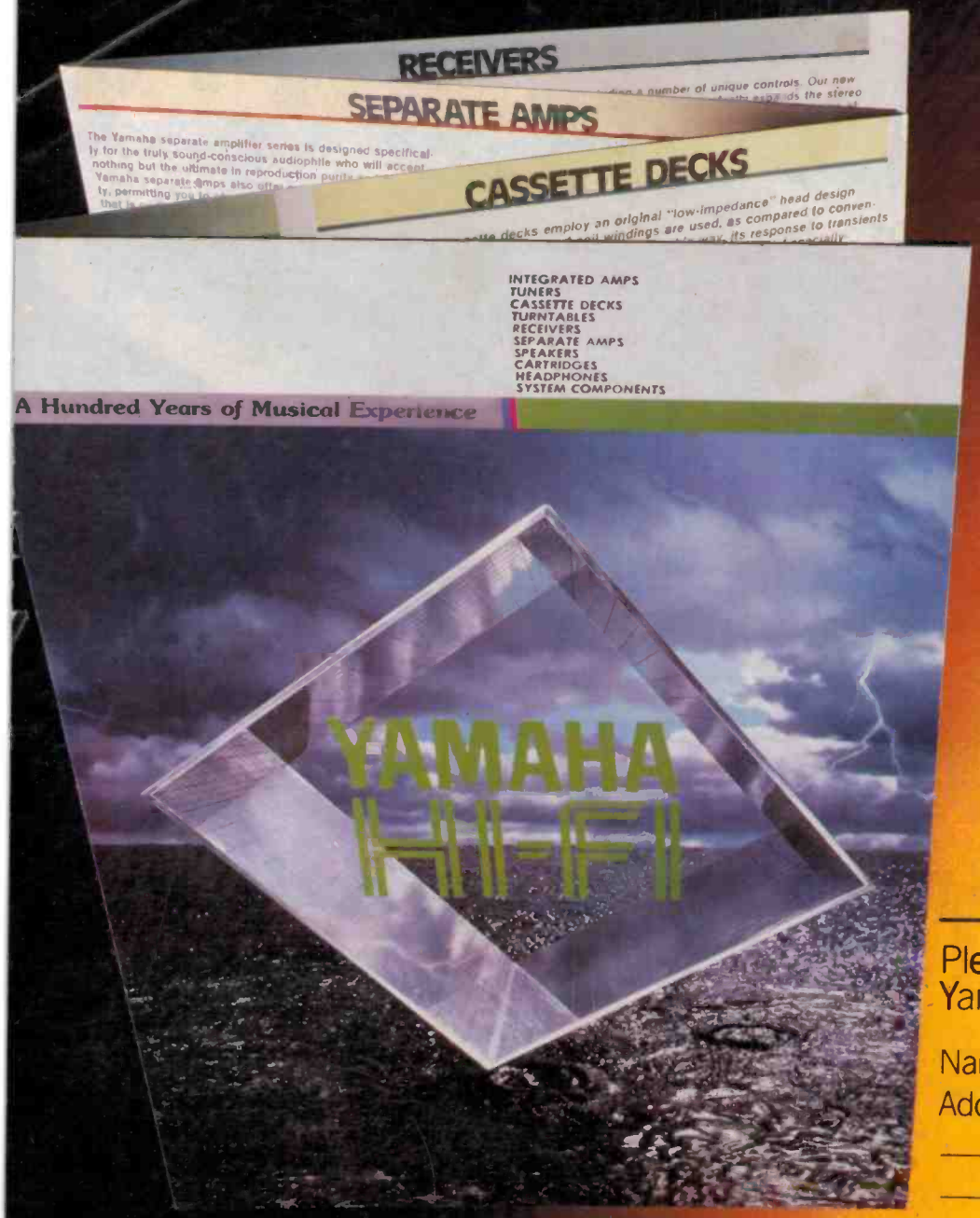

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