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eti ELECTRONICS TODAY INTERNATIONAL

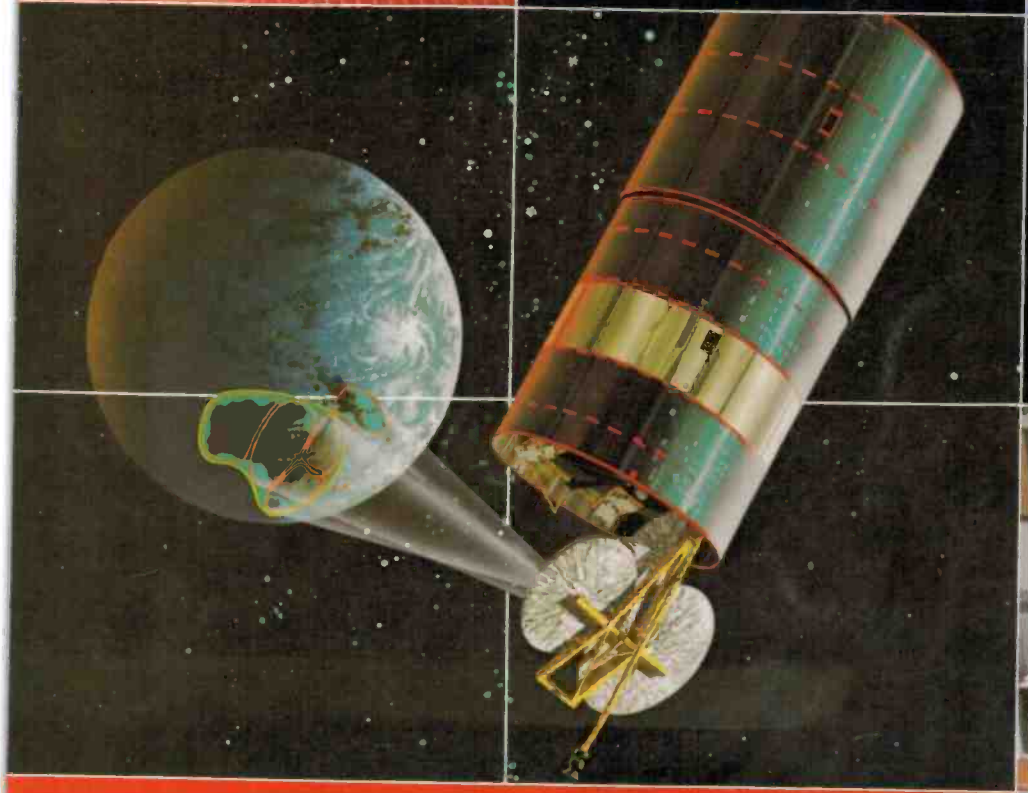
HIFI: NAD "2nd Generation" CD Player Reviewed.

COMMUNICATIONS TODAY

Inside AUSSAT

Computers and Communications

Ionospheric Measurement and HF Communications



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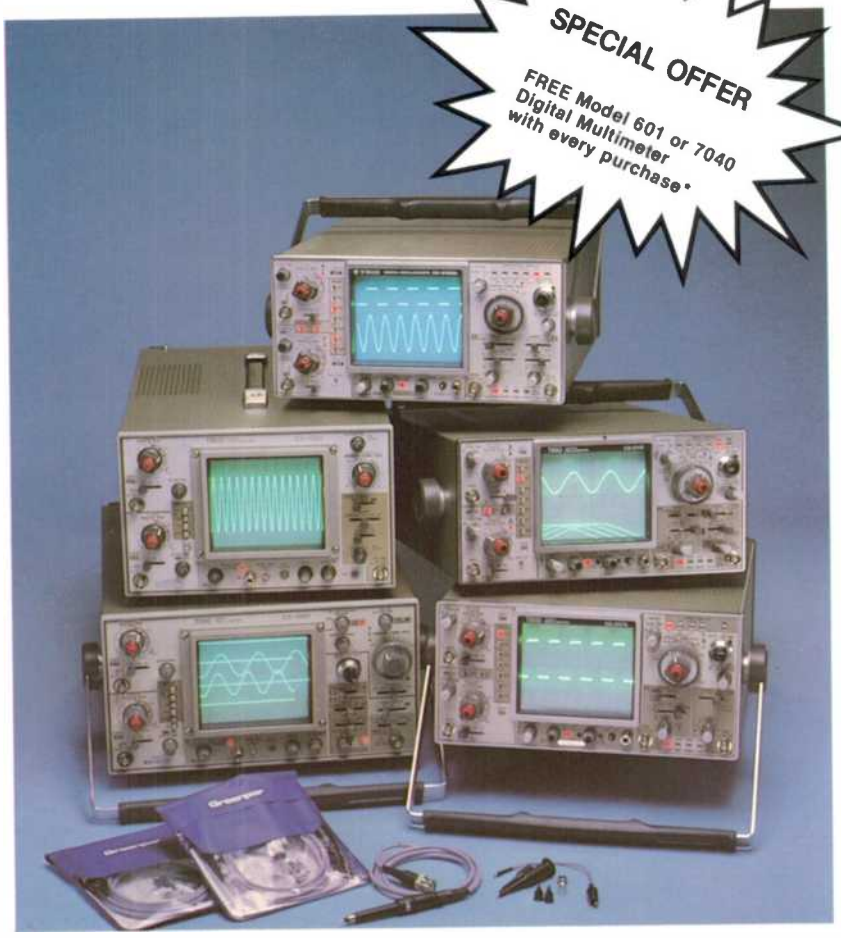

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WHAT'S HAPPENING around here? You may have noticed some changes to the magazine and the crew behind it recently. Our project lab staff swelled by two a few months ago and no doubt you've noticed the results of their labours already. Peter Ihnat joined us just before Christmas, closely followed by Robert Irwin who joined us in January. Welcome aboard the good ship "etty" fellas! Now, I'm sure all you readers out there will treat them with due respect when you call to abuse them on the technical enquiries line because their latest project won't work for you. We'd like to keep them happy and enthused, churning out projects for you! It might not be their fault, you know.

Last month a familiar face around the electronics industry joined us in the hot seat ... er, umm ... Managing Editor's chair, Jamieson (Jim) Rowe. Jim spent the last 4½ years or so at Dick Smith Electronics, for the most part as Technical Director, then latterly as Marketing Manager. Prior to that he spent almost 20 years with Er, Ah, another magazine of note, the last nine years of that stint as Editor. You'll be hearing more from Jim.

For a more complete rundown on these gentlemen's illustrious backgrounds, see page 9.

Hot on Jim's heels came Jon Fairall who has joined us as a technical writer. Jon has been writing freelance articles for some years and you can find an example of his work in the May 1982 issue of ETI, titled *STARLAB — Australian-Canadian Ultraviolet Telescope*. Jon's resume follows next month.

Getting back to the magazine, this is our biggest issue so far this year and our first "theme" issue for some time where we have a number of articles on differing aspects of one 'stream' of electronics. Look for more "theme" issues in the months to come.

We've been evolving our style and presentation over recent months following a re-assessment of ETI late last year. The biggest visible change is our return to the double-page Contents which we ran from 1979 through 1982. Many readers indicated a preference for this sort of format when "shopping" for projects and articles, but there were readers who didn't agree. Let us know what you think of the change. We think it's an improvement.

Now we've a full crew aboard, the good ship "etty" has set sail for the big seas on the horizon. We're in for some interesting adventures. Care to join us?

Roger Harrison
EDITOR

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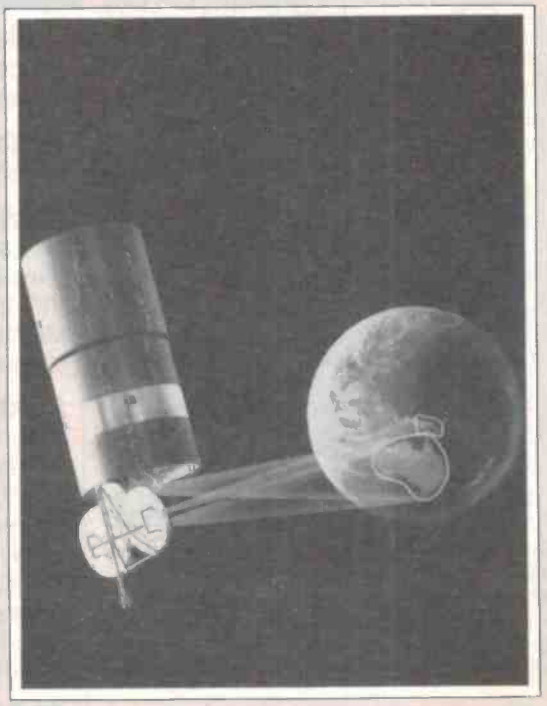
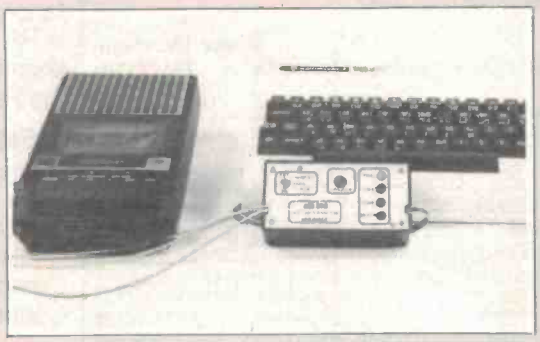


Inside AUSSAT



VIC-20 audio cassette interface

NAD 5200 compact disc player

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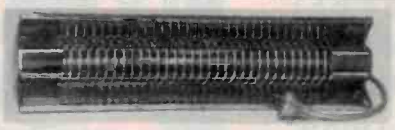
NEXT MONTH

MULTIMETERS

How to choose and how to use multimeters, with special emphasis on handheld models. This article goes into the technology and the techniques of the handiest of instruments every electronics workshop should own.

STRIP HEATER TIME-OUT



Ever left your bathroom strip heater on all day? Sure boosts the electricity bill doesn't it? Well, this simple project automatically turns off the heater after allowing you enough time for morning ablutions, saving you the worry of "have I, or haven't I switched it off?"

Although these articles are in an advanced state of preparation, circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.

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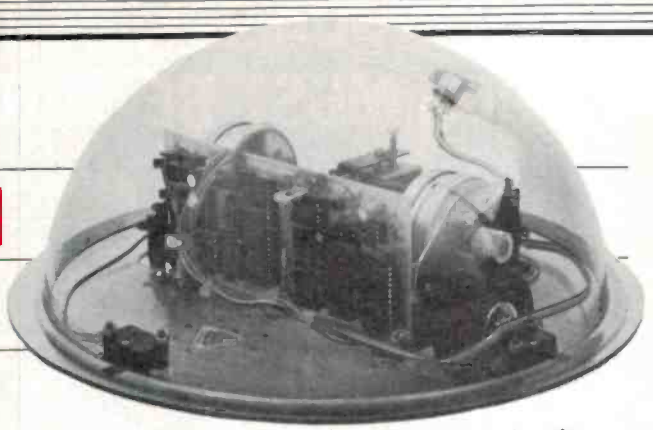
TURTLIN' ON WITH THE TASMAN TOT



Remember the Tasman Turtle from a couple of years back? Well, he's got a little brother . . . the Turtle Tot . . . launched in Australia last month after making his international debut in the United States.

The original Tasman Turtle was, among other things, an ETI kit, project number 645. It was also sold fully built-up to schools as an educational robot. The ETI-645 kit was called the "minimum turtle". It had a round base, two stepper motors, flashing lights, a pen lift solenoid, sensor switches, a tooting horn and the ability to switch these things on and off under the control of a computer.

The idea was to present a mechanical package for experimenters, who could then let their imaginations run wild, driving the Turtle robot hither and tither with a home computer.

The Tasman Turtle was designed with expansion in mind and a later project called "Turtle Talk" even gave it the power of speech.

The full-blown versions, sold to schools and known as "Ultimate Turtles", contained up to four circuit boards stacked vertically. Most of them are still in daily use, connected to Apple computers via a flat cable containing eight data lines, two address lines, read/write, device enable, and power feeds.

Running such programming languages as Logo, the Tasman Turtle can move around over a large sheet of paper, using its pen to draw squares, triangles, stars, or even picture sof people!

The beauty of the system is that the programs are written by schoolchildren who can see instant, concrete results of their efforts.

The new Turtle Tot is a modernized, simplified version of the Ultimate Turtle. The Tot, at 300 mm diameter, is slightly smaller than the Tasman Turtle. Under its plastic dome is one circuit board that handles all its electronic functions.

Communication with the host computer is now by a three wire, 1200 baud RS-232 serial link. And whereas the Tasman Turtle requires the selection of one of four addresses to send commands to, the Tot makes do with one address for all functions, including speech. The Tot's circuit board contains some special logic to allow the use of only one address.

Binary bits 0 through 3 control movement and direction of the two stepper motors. But 4 turns the eyes (lights) on and off, and bit 5 lowers and raises the pen.

Since bits 6 and 7 must both be high for any non-speaking functions to take place, Tot commands are the same as Tasman Turtle commands, plus 192.

The Turtle can send data back to the computer via the serial link. The first four transmit bits are connected to four microswitches around the base that indicate when the Tot has run into something. The fifth bit is fed from the speech circuit to tell the computer when it is busy saying a word.

The Tot's serial communication capability means it can be driven from just about any computer. We haven't yet found one it can't be driven from.

The Tot was developed on a Microbee.

It's since been run on Apple, Atari, Commodore, IBM, VIC-20, the works. Even computers without an "official" RS-232 interface can be used.

The Tot uses hardware delays to prevent it sending while it's meant to be receiving, so communications routines can be developed entirely in software to send and receive serial data through two bits of a parallel port if necessary.

Late last year, Turtle Tot drew a lot of interest when he was exhibited at the Las Vegas and Toronto computer shows. His appearances results in several hundred orders and, as this is being written, he's strutting his stuff at the Didacta education aids conference in Switzerland.

For this occasion we taught the Tot to speak German. His English vocabulary contains all the numbers, 1, 2, 3, 4, 5, 6 etc, up through the hundreds.

When his switches indicate he's run into something, the tot is usually programmed to say something like "Oh!" or "Error!". But in Switzerland, he says "Nein!" (9). (Wonder if they'll like it?).

If you'd like to learn more about the Turtle Tot, and/or how to adopt one, phone or write **Flexible Systems, 219 Liverpool St, Hobart, Tasmania 7000. (002)34-3064.** They'll send you along a detailed fact sheet and, if you're really nice, may even sell you a Tot! They must go to good homes, of course.

TV LIFTING TROLLEY

In the television service and rental industry the risk of serious back injury is an occupational hazard, as heavy TV sets are continuously moved from factory to showroom to consumer's homes.

Now an Australian invention has been developed, with financial assistance from the Australian Industrial Research and Development Incentives Board, to eliminate the problem of 'TV serviceman's back-ache'.

Telelift is a uniquely designed trolley which makes the movement of heavy and expensive TV sets an easy one-man job, instead of a back-breaking chore for two men.

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Once a heavy TV set is locked into place on the Telelift trolley it can be swivelled to a 90° angle to allow easy access through the most awkward doorway.

During transport the receiver cabinet is securely supported and protected from damage by rubberised fold-away feet, while road impact and shock is absorbed and dissipated by the radially-spoked thermoplastic wheels.

Moving a TV set up and down a flight of stairs is easy. 'Stair-climbers' attached to the sides of the trolley reduce operator

NEW FACES AT ETI

Jim Rowe

Jim will hardly need an introduction to many readers! But as he joined us in April as Managing Editor (Electronics Group), it's perhaps timely that we fill in a few details of his background — just for the record.

Jim spent the first two years of his working life as an engineering trainee at AWA's works in Ashfield, NSW. In 1960 he joined the then *Radio, TV and Hobbies* magazine as a technical writer, building projects and writing articles. In the meantime he continued to study part-time at the University of NSW, finally graduating with a B.Sc. in Technology (Electronics) in 1963. Shortly afterward he was promoted as Technical Editor of Radio, TV and Hobbies. In 1967 he gained a B.A. degree from Sydney University.

In early 1971, the name of the magazine was changed to *Electronics Australia*, and Jim was appointed Editor. He held this position until November 1979, when he left to join Dick Smith Electronics as Technical Director. In August 1983 he was made Marketing Director of DSE, as well as retaining overall responsibility for technical matters.

Over the years, Jim has designed and described a huge number of projects and written hundreds of articles. He designed from scratch the first hobby computer described in Australia, earning him the title 'father of hobby computing in Australia'. He has also written well-known books, like *An Introduction to Digital Electronics* (1967), *Fundamentals of Solid State* (1971) and *Getting into Microprocessors* (1977).

Robert Irwin
Project Engineer

Born in 1959 of Irish parents (did you hear the one about Paddy . . .), Robert made a decision early in life to become an engineer, and now he are one. Entering Pendle Hill High School (Sydney) at the age of 12, he purchased an electric guitar (Audition) to substitute for lack of stimulation at school. It worked better after he bought a 10 watt Diason amp, whereupon he learned to play *Smoke on the Water* (doesn't everyone?).

Robert became interested in electronics when the Diason amp began to emit smoke signals in time with a blistering rendition of *Born to be Wild*. After taking the amp apart, he decided to do Electrical Engineering so that he could learn how to put it back together again. (Reportedly, it's still in pieces in the garage!).

He claims to have started reading ETI at age 14 (having found a copy in his dad's drawer and thought it may have rude pictures inside, like National Geographic). Subsequently, Robert built the ETI-422 amp. it was then he decided he needed help. (I'm not surprised! The '422 is a *stereo amp*, you Irish git — Ed.).

To get that help, Robert went to Sydney University to learn poker, 500 and Electrical Engineering. Completing the degree course late in 1983, Robert went to a local fun parlour where he was accosted by a certain bearded editor and accompanying press gang who plied him with strong drink. When he woke up he found himself in a small room with lots of resistors, capacitors and power points festooning the walls

with a sign above the door saying "ETI Lab. Do Not Feed the Staff". There he remains to this day (learning 50 different delicious ways to serve spaghetti with resistor and relay sauce).

Robert played in a Wollongong-based band during 1980-81, called the Bombora Bros. He currently plays in a band called Rafequats Right Foot. Obviously, he's interested in music, specifically, playing and recording, plus synthesisers. In addition, he maintains an interest in photography, pot plants (umm . . .), bushwalking, travel, audio electronics and cooking. Being a Saggitarian, he likes Italian food, Italian women, Tequila, Scotch, books, bad Japanese sci-fi films, staying up late and listening to old Goon Show recordings (Sapristi!). He definitely dislikes getting up early, people who smile before 11 am, people who insist Michael Jackson is more talented than the Beatles and 741 op-amps. His favourite quote is: "Leave me alone, I just got up".

Peter Ihnat
project engineer

Peter was born, raised and educated in the deep south. More precisely, the northern suburb of Wollongong called Woonona (after early settlers heard an aboriginal shout the word whilst riding a runaway horse called Nona).

An early interest in fire terminated after almost burning the house down. He turned away from chemistry because noxious fumes and sickly-

coloured liquids require a strong stomach. Interest in music and electronics developed during Peter's high school years. He taught himself keyboard and joined various bands playing the stomach Steinway (piano accordion) but later converted to horizontal polarisation and now plays synth and electric organ.

Peter's electronic interest turned into a long University career. Enrolment in engineering resulted in a "ramp-type" lifestyle: academic work increasing linearly to exams, falling to nothing post-exams. An offer of part-time work in Astronomy with Wollongong Uni's Physic's Department offered the attraction of perturbing the study-sleep-beertasting cycle. On completing his B.E., Peter took up full time work at Physics under a research grant. It seemed reasonable to attempt a B.Sc., which he completed in 1981. A year later the research grant ran out and Peter became a technical assistant by day and a teacher by night, in Electronics Engineering at the Wollongong TAFE, leaving weekends for debauchery.

Finally, the ideal job arrived — being paid to pursue his hobby. Holding his homebrew portable laser gun and beer tap at the Editor's head, he applied for the position of project engineer.

Peter is an Aries (*post*-April Fool's day); confesses to liking digital electronics, microprocessors, music and photography, not to mention hot food (Mexican, Indian, Chinese, Italian and Ukranian), hot women (ditto), Coopers Ale, Toohey's New, simple/clever gadgets and circuits, and Monty Python — as such. He dislike's Bob Dylan's singing but is no Pavarotti himself; hates cars faster than his Escort panel van and misplacing things. He believes in "He who has no patience is lost" (but I can't wait all month for that article! — Ed.) and has been President of the Wollongong Uni. Camera Club and Director of the Illawarra Planetarium Society.

effort to the absolute minimum while ascending, and provide a safe degree of friction for control while descending.

The extendable handle folds neatly away making Telelift a lightweight, portable trolley which easily fits in the back of a delivery van.

The unloaded weight of Telelift is approximately 9 kg and its height is 0.9 m.

Its design enables TV sets to be lifted and lowered at heights of up to 0.91 m, making the removal of equipment from a stand or the rear of a van an easy task.

The price per trolley is $240. Further information is available **from Telelift (Australia) Pty Ltd, 23 Atchison St, St Leonards NSW 2065. (02)439-6860.**

ACKNOWLEDGEMENTS

March 1984, Shuttle-to-Houston via Amateur Radio, pp15-18. The author of this article, Philip Clark VK2KPG, advises that some additional acknowledgements should have been included in the article, but the information was not to hand when it was being prepared. He would like to acknowledge Telecom Australia for generously waiving normal charges regarding the Houston phone-patch and for valuable assistance in obtaining approvals from within and outside their organisation. In addition, the building housing the Deakin Switching Centre, in which the equipment was installed, belongs to Telecom, for which the author extends thanks to Telecom for both the use of the building and facilities.

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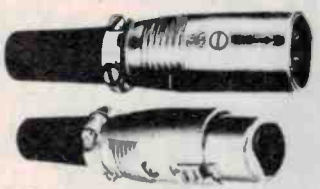

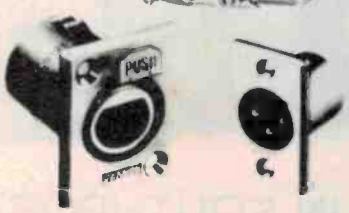

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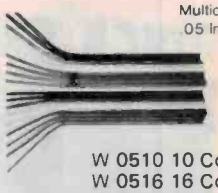

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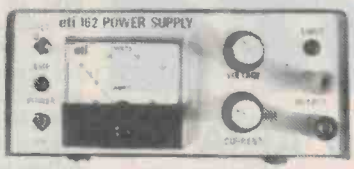

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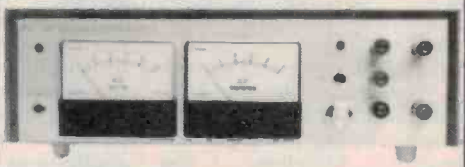

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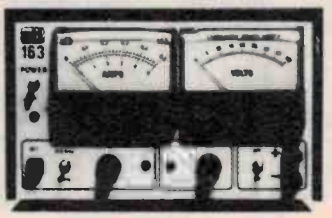

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NEW AEIA EXECUTIVE DIRECTOR

Mr David Hutchinson has been appointed the first full-time Executive Director of the Australian Eletronics Industry Association (AEIA).

The AEIA, a division of the Australian Electrical and Electronics Manufacturers' Association (AEEMA), appointed Mr Hutchinson to succeed Mr Hodgkinson, who has retired as part-time Executive Director.

Based in Sydney, Mr Hutchinson is working from the AEIA offices in the Chamber of Manufacturers building.

Mr Hutchinson has an impressive background in the telecommunications and electronics industry having worked for Standard Telephones and Cables Pty Limited as an engineer, and later joint Managing Director of GTE (Aust) Pty Limited and Manager of Defence and Allied Products for Plessey (Aust) Pty Limited.

ROBOTS — THE 'RIGHT ARM' OF INDUSTRY

We should not sit around waiting for the ideal robot to arrive but harness the mechanical creatures that already exist. Robots should be the 'right arm' of industry now, rather than later, says a robotics expert, Dr Chula na Ranong.

Dr na Ranong, a senior lecturer in digital electronics and systems at the Footscray Institute of Technology in Melbourne, recently returned from Japan where he studied robots. He brought back a $40 Japanese toy robot sold for children. To them it's a plaything and part of everyday life, but here talk of robots is frightening, he said.

"We have a lesson to learn from the Japanese — that while the perfect robot has yet to be created, there's a lot to be gained from those that are around now."

Dr na Ranong was amazed by some of the new Japanese robots, particularly one that wrote two Chinese characters — spelling new technology — on a grain of rice. "That is accuracy to the degree of one micron (0.001 mm). That is extraordinary precision which will be invaluable in producing things like optical instruments," he said.

Another great robotic advance he saw was a mechanical guide dog for the blind. Looking rather like a vacuum cleaner, the robot dog, Meldog, can guide blind people around their neighborhood, although it is not yet sophisticated enough to take them into areas it is not programmed for.

At the $5000 million Tsukaba Science City, 60 km north-east of Tokyo, which has almost 40 universities and institutes, a robot with caterpillar tractor-like legs, has been built to climb stairs. This mechanical man would be perfect for working in a nuclear plant to adjust controls in areas where it was perilous for humans to approach, Dr na Ranong said.

Australia had yet to realise the potential of robots, although our sheep-shearing robot intrigued the Japanese.

"Some companies have realised robots can counteract workers' compensation costs. More robots are being brought into jobs that are producing tenosynovitis in workers (wrist injury from repetitive action)," he said.

BICENTENNIAL ROBOT EXPOSITION

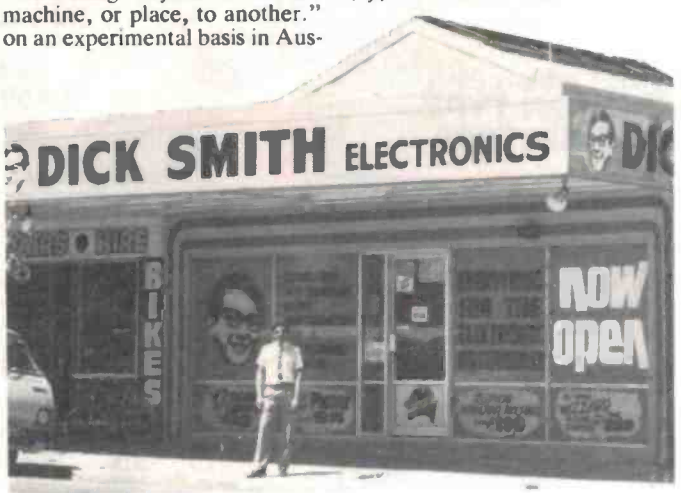
The 19th International Symposium and Exposition on robots will be held in Sydney in 1988 as part of Australia's national Bicentennial celebrations.

More than 1000 delegates from home and overseas will attend the November symposium at Sydney's Hilton Hotel and thousands of people will have the opportunity to explore the world of robot technology at the Exposition in Centrepoint.

Papers presented at the symposium will discuss the complex applications and implications of robot technology in modern society and the exposition will provide a range of practical demonstrations of robots at work in industry, the home and educational institutions.

Dr Michael Kassler, convenor of the Association's steering committee, says, "Robots are already at work in industry and perform a number of tasks such as welding, spray painting and transferring objects from one machine, or place, to another." on an experimental basis in Australia.

"They have even been used, tralia, to shear sheep. We anticipate that by the latter part of this decade robots equipped with visual sensors wil be used for automatic assembly in industry," Dr Kassler said.



4TH HONG KONG FAIR

The 4th Hong Kong Electronics Fair, featuring the very latest design and technological advances in computers, telecommunication products and audio/video equipment, will take place on 2-4 October 1984, at the Hong Kong Exhibition Centre.

The electronics industry has burgeoned rapidly to become Hong Kong's fastest-growing revenue earner, second only to textiles and garments in export value. Electronic wizardry runs the full gamut from audio and computer systems to sophisticated telecommunications equipment such as cordless telephones, digital dialers and telephones with built-in memories.

For further information contact **Hong Kong Tourist Association, Bligh House, 4/6 Bligh Street, Sydney. (02) 232-2422.**

DICK SMITH IN SOUTHPORT

Now the Gold Coast's electronics enthusiasts have got their very own Dick Smith store which will stock everything from components to kits, home computers, telephone products, car sound systems, books on all facets of electronics, etc.

Store manager, Nigel Wickson and his staff are looking forward to serving you, according to the press release.

The new store is located at the **Corner of the Gold Coast Highway and Welch St, Southport Qld**, and the phone number is **(075)32-9033.**

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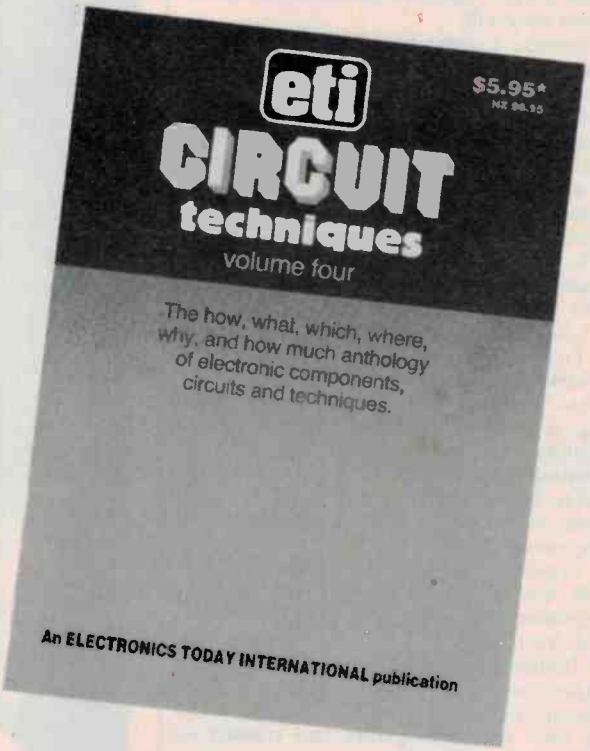

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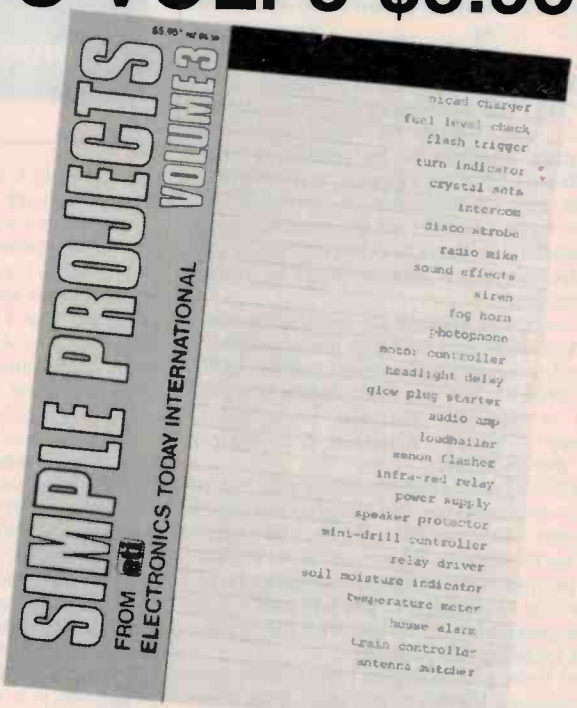


Inside the communicat

Jennie Whyte

WHEN AUSTRALIA'S first two communications satellites are launched in 1985 the entire country will be covered, for the first time, by a comprehensive communications system. Once the satellites are operational they will:

- Provide a direct broadcasting service of television and radio to people in remote and underserved areas of Australia which cannot be reached effectively by terrestrial means. This includes almost 300 000 people currently outside the normal coverage area of existing ABC television and radio transmitters, and those receiving a technically inadequate service. These people will be able to receive their TV and radio programmes direct from the satellite using a dish antenna with a diameter of typically 1.5 m.
- Provide Telecom with the means to introduce a telephone service to those remote areas of Australia beyond the reach of existing or planned terrestrial communications systems. It is estimated that up to 40 000 Australians in these areas rely on comparatively poor quality high frequency (HF) radio as the means of communicating with the outside world.
- Provide a more cost effective and flexible method of distributing and relaying television and radio programmes throughout Australia.
- Enable authorities responsible for educating people who live in remote areas to expand significantly their services in terms of both technical quality and transfer of education information.
- Provide the basis for the introduction and/or expansion of communications to mining and similar ventures giving such services as data, facsimile and videotex.

The satellites will also have provision for extending domestic telecommunications and broadcasting services to Papua New Guinea should that government decide to use this system.

National satellite system

AUSSAT, the Australian national satellite system, will initially be based upon two operating satellites to be placed in orbit 36 000 km above the equator, at a longitude a little east of Australia. A third satellite will be kept available on the ground and is expected to be launched later to meet the anticipated future high demand in traffic requirements.

To own and manage the satellite system, the Australian Government has established a satellite operating company called AUSSAT Pty Ltd. The Commonwealth Government is currently the sole shareholder, however, Telecom Australia is to take a 25% shareholding.

AUSSAT has entered into a number of major contracts for the supply of various elements of the satellite system and associated earth stations. These contracts will not only provide substantial Australian content, according to AUSSAT, but will also result in the placement of orders with Australian firms totalling $70 million.

The three satellites plus two satellite control stations, known as tracking, telemetry, command and monitoring stations, are to be supplied by the US-based Hughes Communications International which will also provide launch and operational services and ground support.

Hughes has awarded contracts to several Australian firms. Standard Telephones & Cables (STC) is providing the electrical wiring harnesses for use in the satellites. J.N. Almgren Pty Ltd, Data Communications Engineers, is designing and building two voice communications systems for in-house communication at the Sydney and Perth major earth stations.

Amalgamated Wireless (Australasia) is designing, manufacturing, integrating and testing two subsystems of the AUSSAT Tracking, Telemetry, Command and Monitoring (TTC and M) system. The communications systems monitor network will monitor the satellite communications payload and the ground station communications performance. The TTC and M station management subsystem comprises a computer controlled, automated facility to assist in the efficient running of the station.

Mitsubishi Australia Ltd is supplying eight major city earth stations and approximately half of the contract value (around $16 million) is to be spent in Australia. Mitsubishi has established a new communications factory at North Ryde near Sydney to assist in fulfilling this requirement.

AUSSAT is also purchasing 21 smaller earth stations which will be supplied by Codan Pty Ltd of Adelaide, Mitsubishi Australia and Sumitomo Australia Ltd.

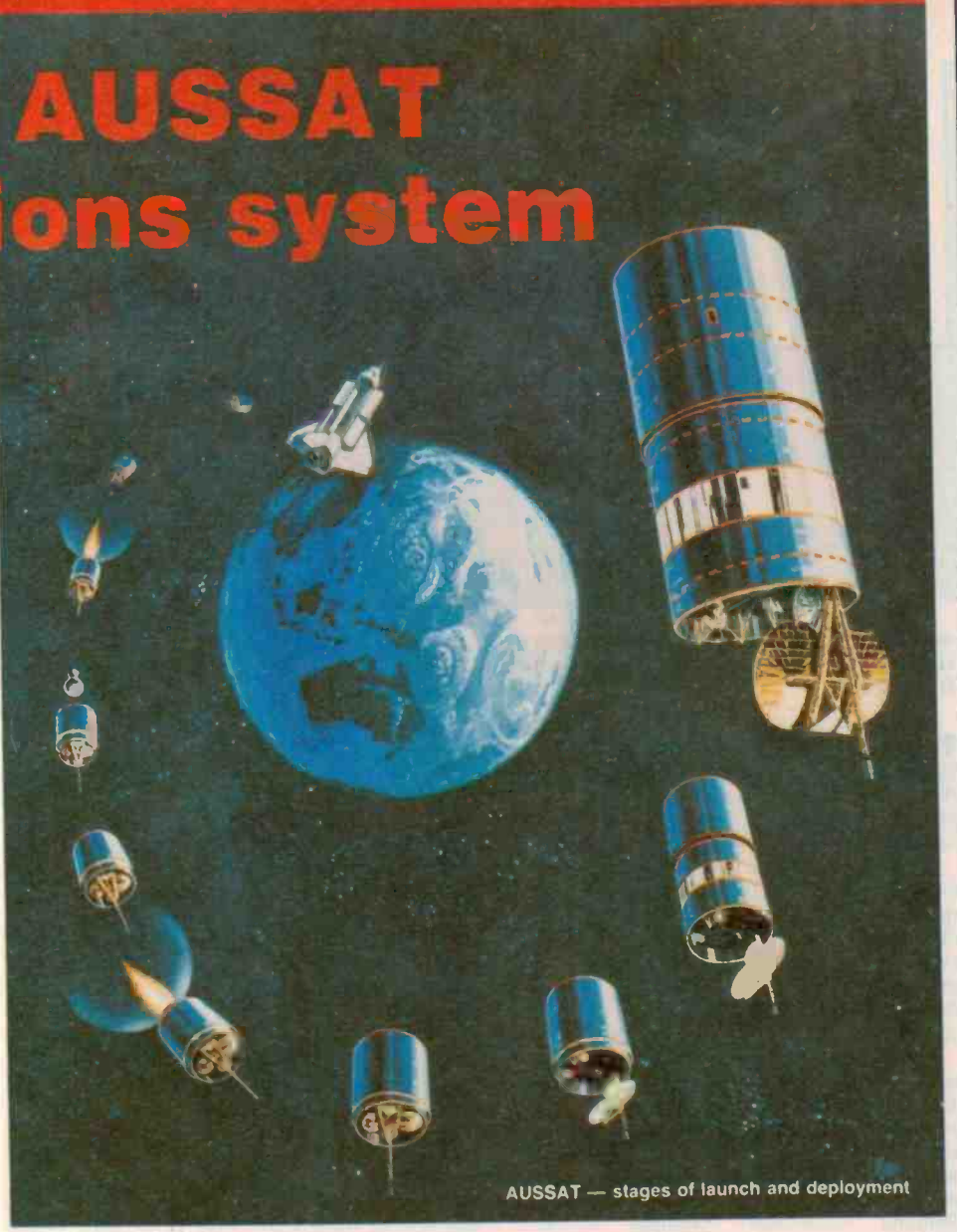
The US Space Agency NASA has been contracted to launch the two satellites, one each in July and October, 1985, via the Space Shuttle.

Based upon conservative estimates of use of the satellite system, AUSSAT projections indicate that the company can recover its costs, repay its loans and generate reasonable dividends during the life of the first generation of satellites (1985-92).

Potential users of satellite system.

The Australian Broadcasting Corporation will be a major user of the satellite system's services. The ABC will relay programmes between studios, distribute programmes to

AUSSAT
ions system



AUSSAT — stages of launch and deployment

provincial transmitters, provide the Homestead and Community Broadcasting Satellite Service (HACBSS), and distribute their Radio Australia shortwave broadcast programmes from studio to transmitter.

Commercial television and radio networks can use the system for transmission of programmes between major studios and to improve programme relay facilities to regional stations.

Outback communities will receive television and radio services through the HACBSS service using high-power transponders on board the satellites.

The Department of Aviation is planning a network of more than 100 earth stations to link air traffic control and flight service centres to aircraft.

The Department of Defence will use the system for internal administrative communications.

Telecom Australia is planning to use the satellite system in a variety of ways, including the provision of fully automated telephone services to remote locations, multiple circuits to outlying communities and back-up circuits on existing routes. Remote communities could have expanded access to telex, facsimile, PABX and data transmission facilities.

The business community, including banks, could use the satellite system for electronic funds transfer; mining companies for voice, video and data transmission from remote mine sites to head offices; manufacturers for expanded management information systems and retailers for expanded merchandise control systems.

The public sector, in particular remote education services, will be able to improve the education services delivered to remote areas through agencies such as the School of the Air.

EARTH STATIONS

Major city earth stations

Eight AUSSAT-owned major city earth stations (MCESs) are being purchased from Mitsubishi Australia and will be installed in the six state capitals as well as in Canberra and Darwin.

The most important earth stations in the National Satellite System are located at Belrose near Sydney and Lockridge near Perth. The Belrose earth station is a primary satellite control, monitoring and communications operations centre. It consists of two communications antenna (one directed at each satellite) and a full-motion tracking antenna associated with the co-located satellite control and operations centre. This station will control the launch and subsequent operation of the satellites in orbit.

The earth station at Lockridge is a similar key control station and can backup the Sydney station.

The stations in Adelaide and Darwin will also be equipped with two communications antennas, one dedicated to each operating satellite; the remainder will have initially only one antenna.

The size of the Darwin and Brisbane antennas is 18 m and the size of all the other antennas is 13 m, with dual polarisation transmitters/receivers. Both sizes of antenna have a Cassegrain feed with a polarisation discrimination of better than 30 dB.

The gain-to-temperature ratio (G/T) is 38 dB/K (18 m dish) and 36 dB/K (13 m dish) with GaAs FET low noise amplifiers (LNAs) with a noise temperature of 250 Kelvin. GaAs FET receivers with three-for-two redundancy (two in use, one on standby) will provide low-noise front-end amplification in each station.

Two sizes of high power amplifiers (HPAs) are to be used, with 600 Watt travelling wave tube amplifiers (TWTAs) providing primary transmitter power for most applications. Two-kilowatt klystrons with two-for-one redundancy will be used for services requiring higher power uplinks.

In most instances, transmit power control will be provided to combat uplink signal loss during heavy rainfall. The power control dynamic range will depend upon the local rainfall levels at each MCES site and is shown in Table 1.

The available transmit Effective Isotropic Radiated Power (EIRP) for the various services is specified in Table 2.

The MCESs will provide uplink and downlink access to the satellite and monitor the RF traffic with the communications system monitor. This system measures signal parameters such as power level, peak deviation and occupied bandwidths, and will also determine the interference, intermodulation, gain and other parameters of the satellite transponders.

The MCESs are designed to operate under minimum supervision and are equipped with a fully interactive computer-operated status monitoring and control system that connects via a network time-shared data link to a central computer and supervisory console in the Sydney communications operations centre.

Transmission services are initially available for customers at the earth stations for the following signals:

- 625-line PAL analogue television (program interchange and distribution).
- Analogue 15 kHz sound programme (programme interchange and distribution).
- Digital data to 56 kilobits per second.
- Voice channel (analogue or PCM digital). ▶

Station	TV and sound interchange	HACBSS TV and sound
Sydney	0	4
Brisbane	3	5
Adelaide	0	2
Perth	0	4
Darwin	6	8
Melbourne	0	2
Canberra	0	3
Hobart	0	—

Table 1. Uplink rain attenuation compensation (dB)

Carrier	EIRP level per carrier (dBW)	Uplink rain compensation
TV interchange	83	Yes
Sound program interchange	66	Yes
HACBSS TV	83	Yes
HACBSS sound	71	Yes
AVD(SCPC/Digital)	55	No
Voice channel (SCPC/CFM)	50	No

Table 2. Earth station EIRP capability.

Parameters	Full Transponder	HACBSS
Video		
Peak-to-peak carrier deviation (MHz) (Note 1)	30	10-20
Occupied Bandwidth (MHz)	40	24
Video Bandwidth (MHz)	5	5
Audio		
Sub-carrier frequency (MHz)	6.6	6.2
Peak-to-Peak test tone deviation (kHz) (Note 2)	300	150
Occupied Bandwidth (kHz)	875	450
Audio Bandwidth (kHz)	15	15
Pre-emphasis		50 microseconds

Note 1: Peak-to-peak carrier deviation is caused by application of a one volt peak-to-peak video signal applied at the pre-emphasis crossover frequency. A transition from blanking level to peak white will produce an increase in frequency.
Note 2: Peak-to-peak test tone deviation is caused by application of an audio tone at the peak program level and 1.42 kHz frequency.

Table 3. Television characteristics.

AUSSAT also has the capability of uplinking a signal supplied to it.

Provision has been made in the initial installation at each MCES for two specific transmission services, for television and for narrow band signals carried by single channel per carrier (SCPC) methods.

Television equipment will transmit and receive a PAL-encoded colour television video signal. The associated sound carrier signal will be carried by a frequency modulated sub-carrier. The television characteristics are shown in Table 3.

Four types of SCPC channel units will be provided.

Type 1 — alternative voice and data (AVD) — selectable to carry 56 kb/s corrected data or a 3.4 kHz voice circuit.
Type 2 — voice only — to provide a 3.4 kHz voice circuit.
Type 3 — programme sound interchange — to provide a high quality 15 kHz programme sound circuit.
Type 4 — HACBSS sound broadcasting — to provide a high quality 15 kHz programme circuit for the HACBSS and relay service.

Minor earth stations

For marketing applications and field demonstrations to a variety of users requiring low cost, low capacity earth stations, AUSSAT is purchasing a total of 21 minor transmit/receive earth stations from Sumitomo Australia Ltd, Codan Pty Ltd and Mitsubishi Australia Ltd.

The 15 standard units have small antennas with a dish size of between 2.1 m and 2.4 m, a G/T of 22 dB/K and a transmit EIRP of 48 dBW.

The six high performance (enhanced) units use larger antennas with a dish size of between 3.3 m and 4 m, a G/T of 26 dB/K and a transmit EIRP of 52 dBW.

All the earth stations have GaAs FET LNAs with a noise temperature of 220-250 Kelvin and 1-1.5 Watt solid state power amplifiers (SSPAs). They are designed to be ruggedly constructed and transportable.

Two types of voice modems have been offered by the suppliers: SCPC/companded FM, and SCPC/Quadrature Phase Shift Keying with a special form of high performance adaptive delta modulation. The SCPC channel units operate on preassigned frequencies.

Telecom earth stations

Telecom Australia is purchasing 65 earth stations from NEC Australia Pty Ltd to provide telephony and other telecommunications services to remote areas.

These include 60 remote telephony stations (antenna size is 3.7-4.5 m) and five special purpose transportable stations (antenna size is 4.5-6.4 m) which will be available for itinerant use such as in emergencies or disaster relief situations. These stations have GaAs FET LNAs with a noise temperature of 220-350 Kelvin.

A main control station with a 1 kW high power amplifier (HPA) and an antenna dish of 6.4 m will be installed at Bendigo in Victoria. This station will serve as the interface with the terrestrial telephone network and will provide signalling as well as centralised control of the system's Demand Assignment Multiple Access (DAMA) facility.

The DAMA system has been designed to serve up to 2000 subscribers with a very low probability of being fully used.

The initial service in 1985 is expected to extend telephony to approximately 400 remote area subscribers and will use SCPC/companded FM transmissions in a 12 Watt national beam transponder.

The remote stations fall into two basic categories:

- Low capacity stations capable of supporting only a small number of voice channels. These have 1-3 W solid state power amplifiers.
- Higher capacity stations capable of supporting 12 voice channels (these stations use a single 15 W travelling wave tube HPA for multi-channel uplinking).

To achieve high service availability, particularly in high rainfall areas, uplink power control will be provided using a pilot reference signal radiated in the telephony transponder from the control station. This pilot will be slaved in level to one of the spacecraft telemetry beacons and shall serve as a reference for other stations in controlling their respective uplink carrier levels.

The primary task of this system will be to maintain a constant carrier signal level at the satellite, despite absorption caused by rain and intermodulation noise caused by heavy usage of the channels.

DOA earth stations

The Department of Aviation (DOA) is purchasing 202 aeronautical earth stations from NEC Australia Pty Ltd. They will be installed in identical pairs at 101 separate locations to establish reliable voice and data links between 46 major manned air traffic control and flight service centres throughout Australia.

The system will also be used to provide full VHF air-to-ground coverage on all domestic commercial flight routes above 6000 metres. To achieve this 55 unmanned remote VHF air-to-ground outlets will be installed with satellite links connecting each outlet to a designated manned centre.

The remote outlets will have an antenna with a diameter of between 3.6 and 4.6 metres, 3-6 W SSPAs and up to two voice channels. The manned centres will have an antenna with a diameter of 4.6 m, 40-100 W TWTAs and 24-72 voice channels. SCPC/companded FM with preassigned frequencies will be used.

Other earth stations

Thousands of small, low cost television and radio receive-only earth stations will be privately owned for the remote area direct broadcast HACBSS service. The domestic earth stations will consist of a 1.2 to 2.4 metre (typically 1.5 m) diameter antenna with mount, outdoor electronics unit (low noise converter) and a television indoor unit. They should be low in cost, be easy to transport and relatively straightforward to install.

About 122 communities could receive the HACBSS service by using community-owned earth stations. In most cases the antenna dish would be 2.4-3 metres in diameter and thus capable of providing a signal suitable for redistribution. The signal could be fed either by cable into individual homes, or retransmitted by low-

powered transmitters to be received by conventional antennas in individual homes. In these communities this arrangement would lower the cost to individual households.

There will also be hundreds of television and radio relay earth stations for public and commercial broadcasters, as well as hundreds of small low-to-medium speed digital data earth stations for business and government use.

Broadcasting services

The AUSSAT system will provide two important types of services in relation to the broadcast and distribution of television and radio programmed throughout Australia.

The HACBSS service will extend radio and television services to people in remote areas, and to those whose reception is technically inadequate.

A satellite distribution service will provide broadcasters with the means of interconnecting production studios for programme interchange, as well as facilitating the relay of programmes from major studios to other centres for further distribution.

HACBSS service

The remote area Homestead and Community Broadcasting Satellite Service (HACBSS) will be operated by the ABC and will use four 30 W spot beam channels to provide direct satellite broadcasting of one ABC television programme and at least two ABC radio programmes to each region.

This service will require users to purchase high performance 12 GHz receive-only earth stations. The units should have a gain-to-temperature ratio of 16 dB/K which will give a carrier-to-noise ratio of approximately 11.5 dB (for the 47 dBW EIRP edge of primary coverage, clear sky). Thus the HACBSS operating point under clear sky conditions is around 1 dB above FM threshold.

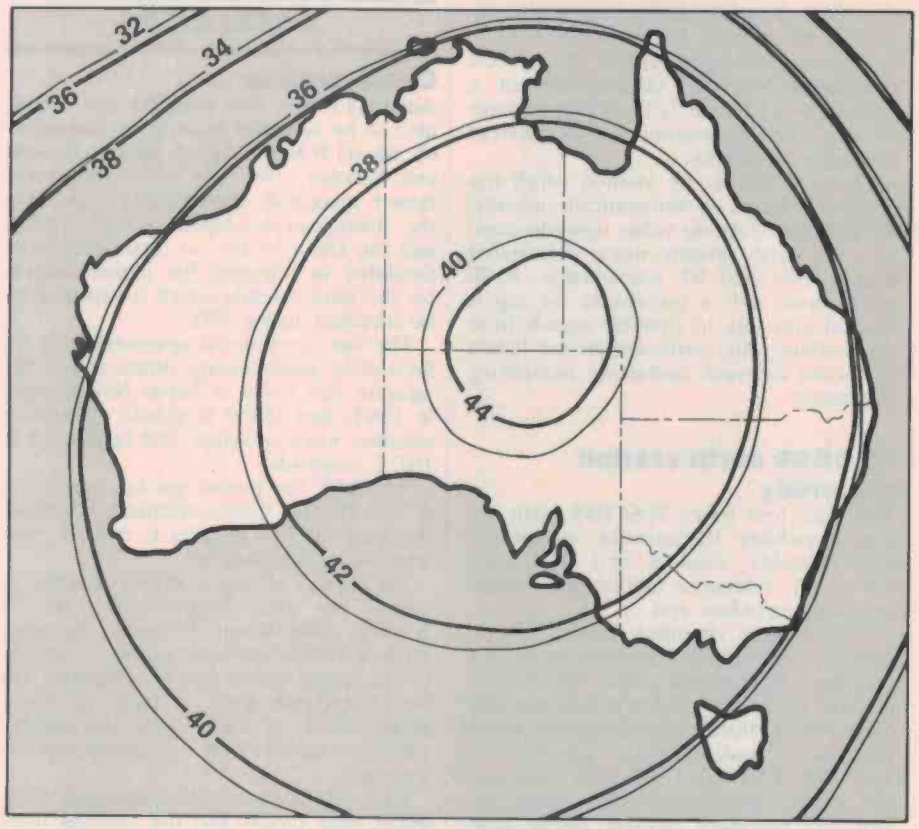
These programmes will also be received from the satellite at existing ABC transmitter stations in country areas for rebroadcast to local communities.

HACBSS test programme

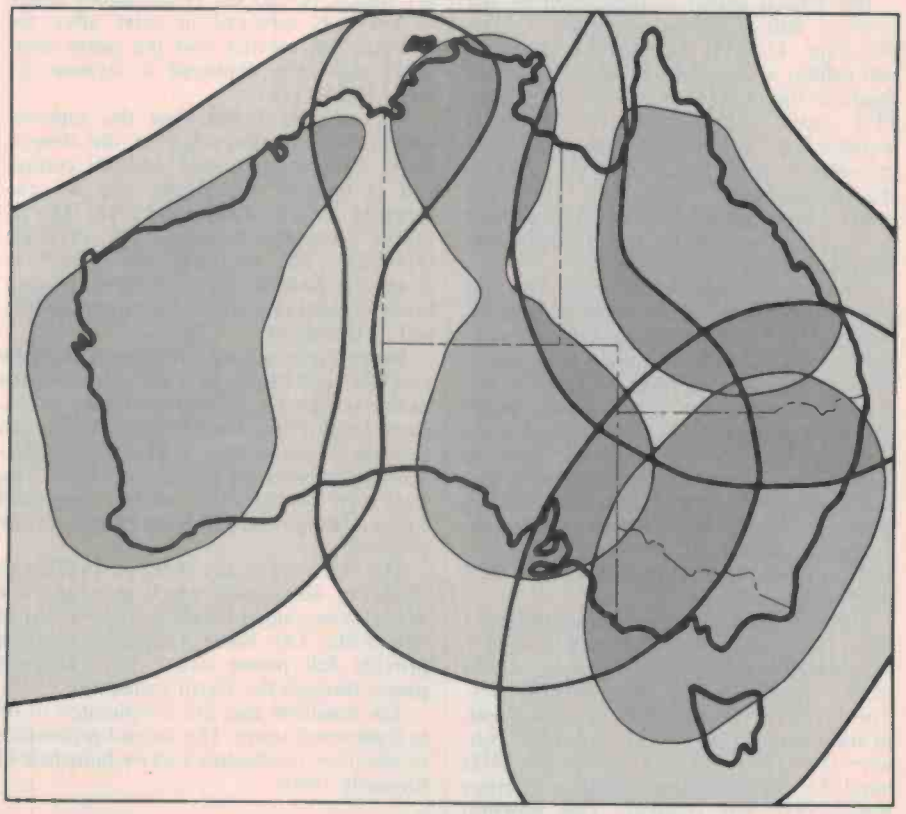
The achievable field performance of the domestic reception hardware is a critical factor to be considered when formulating the satellite broadcasting system standards. As the Minister for Communications is responsible for setting standards for broadcasting services, the Department of Communications has been conducting an extensive field and laboratory test programme.

About 131 prototype earth stations are being tested and the resulting information will be used by the Department in the formulation of HACBSS system standards and earth station specifications. Groups of approximately 40 stations were placed at monitoring test sites in Queensland, WA and the NT to determine how they cope with extremes of environment.

The key factor affecting the viability of ▶



Map 1. The national A beam EIRP (dBW) from 160°E longitude showing the 30 W (thick line) coverage and the 12 W (thin line) coverage.



Map 2. Typical EIRP performance (dBW) for the 30 W channels in each spot beam at 160°E. The shaded area shows the 47 dBW primary coverage and the 42 dBW secondary coverage is shown covering the larger area.

HACBSS reception under clear sky conditions is the stability of earth station G/T. The most challenging aspect of the test programme was the development of a method by which the G/T stability of earth stations could be monitored in the current absence of a satellite.

The G/T monitoring method which has evolved is based on automatically measuring the demodulating video signal-to-noise of each earth station when illuminated with a controlled RF transmission. A 30 metre mast with a transmitter on top is used at each site to simulate signals from the satellite. The earth stations are linked to special caravans containing monitoring equipment.

HACBSS earth station assembly

There are four major HACBSS earth station assemblies: the antenna, mount and feed assembly; outdoor unit (low noise converter); television indoor unit; sound broadcasting indoor unit.

The satellite downlink signals corresponding to either the horizontal or vertical polarised transmissions are fed by the antenna to the input of a broadband (500 MHz wide) block down-converter which frequency translates these signals to a 1000-1500 MHz first IF. The television and sound broadcasting indoor units provide the necessary receiver tuning function, FM demodulation and remodulation to interface with existing television and VHF FM sound broadcasting receivers.

The typical circuit configuration of the outdoor unit is shown in Figure 1. The two-stage 12 GHz GaAs FET amplifier will exhibit a gain of 15-20 dB with a noise figure in the range of 3-3.5 dB. The GaAs FET super high frequency oscillator is stabilised by a dielectric resonator and operates at about 11.35 GHz±1 MHz in the temperature range of −30°C to +60°C. The unit is powered via a dc feed from the TV indoor unit through the interconnecting coaxial cable.

The input stage of the indoor unit (shown in Figure 2) is essentially a UHF varactor tuner with a higher operating frequency. The video output is passed through a low pass filter to remove the sound sub-carrier and then de-emphasised. The sub-carrier output of the demodulator is passed through a bandpass filter to remove the video, FM demodulated and fed to the aural input of the remodulator. The receiver tuning is stabilised using an automatic frequency control amplifier circuit involving the varactor turner local oscillator.

Figure 3 shows the proposed method of implementing the sound broadcasting service which incorporates two or three FM SCPC signals in the same transponder. The sound indoor unit takes a second split of the outdoor unit first IF and block converts the SCPC signals to the 88-108 MHz band for demodulation using a conventional VHF FM receiver. This function can be implemented using a mixer and tunable local oscillator followed by an 88-108 MHz buffer amplifier.

SATELLITES

Configuration

Australia's first two satellites are scheduled to be launched from Cape Canaveral on board NASA's Space Shuttle in July and October, 1985. AUSSAT has maintained spacecraft compatibility with both the European-developed Ariane rocket and the Delta rocket, to retain maximum flexibility in selecting the launch vehicle for the third satellite which is expected to be launched during 1988.

The two operational spacecraft will be located in geostationary orbits above the equator, just north of Papua New Guinea at 156°E and 164°E longitude. The third satellite, when launched, will be located at 160° E longitude.

AUSSAT has posted ten key specialists to the Hughes Communications construction plant at Los Angeles to oversee construction of the satellites.

The design of the AUSSAT satellite is based on the Hughes-built HS-376 spinning drum design. However, the large single reflector antenna system, common to the twenty earlier HS-376 satellites, has been replaced with a more complex arrangement of three separate smaller reflectors mounted on a common support structure.

Each satellite uses two telescoping cylindrical solar panels and the antenna folds for compactness during launch. In its stowed configuration it measures 2.2 m in diameter, 2.8 metres in length and has a dry weight of 528 kg. A maximum length of 6.6 m is achieved in orbit after the antenna has erected and the outer solar panel has been deployed to expose the inner solar array.

The antenna system and the repeater components are mounted on the despun shelf, whereas the power, attitude control and propulsion subsystems are on the spinning section of the spacecraft. The dc power is supplied to the despun shelf via slip rings. The receivers are located as closely as possible to the receive antenna feeds to minimise losses and optimise the G/T performance.

Immediately opposite the rim shelf on the external spinning drum is the quartz mirror radiator. This arrangement provides an efficient heatsink for the TWTAs which, with case temperatures around 60°C, are the hottest components on the despun shelf. The dual spin configuration of the spacecraft offers a benign thermal environment for the payload.

The electrical power system uses K7 high efficiency solar cells which provide 1054 Watts at beginning of life and 860 Watts at end of life. Two Nickel Cadmium batteries provide full power when the spacecraft passes through the Earth's shadow.

The available fuel life is estimated to be at least seven years. The second generation of satellites is scheduled to be launched in the early 1990s.

Communications system

The spacecraft communications subsystem has 15 active transponders operating in a dual polarisation frequency re-use scheme with eight transponders on one polarisation plan and seven on the other. Each transponder receives, translates and retransmits the microwave band from the earth stations.

Four transponders will use high power, 30 Watt TWTAs to provide either the HACBSS service on four transmit spot beams or three satellite programme services (SPSs) when switched to national beams.

The other 11 transponders will use 12 Watt TWTAs which will provide a range of services, including fixed satellite services (FSSs) or SPSs. These transponders receive communications signals via the national receive beams and transmit via national or spot beams as specified in Table 4 which gives the transmit beam switching capability.

The coverage of the national beams is shown on Map 1 and that of the spot beams is on Map 2.

The spot beams have an EIRP of 47 dBW. The HACBSS service spot beams will be placed over the western, central, northeast and southeast regions of the Australian continent. There is also a spot beam over Papua New Guinea.

The national A and B beams have an EIRP of 36 dBW and a G/T of −3 dB/K. In some parts of the coverage area these EIRP patterns differ by up to 3 dB.

Six-for-four redundancy is provided for the 30 Watt TWTAs, and 13-for-11 redundancy is provided for the 12 Watt TWTAs. In both cases, redundancy is implemented via an input and output switching system.

The elaborate switching system on each satellite will make it possible to connect the communications channels individually to the transmit beams. After a radio command from Earth, the satellite's mode of operation can be re-configured to satisfy individual user requirements. Transponders can be switched from spot beams to national beams a number of times each day, if required. This will enable the satellite system to be rapidly adapted to changing operational circumstances.

In addition to normal free space and atmospheric attenuation, the microwave band suffers degradation, for small percentages of the time, due to rainfall. Rain attenuation can reduce the received signal and increase the receiver system noise temperature which is only significant on the down link.

Prediction of the rain attenuation is only possible based on a small number of attenuation measurements and cannot be made with great accuracy.

Frequency plan

The satellites will operate exclusively in the Ku band, receiving in the range 14-14.5 MHz and transmitting in the 12.25-12.75 MHz frequency range.

Figure 4 illustrates the frequency and polarisation plan. The 15 RF channels provided on each satellite use orthogonal horizontal and vertical polarizations. Channels 1-8 constitute repeater A and channels 9-15 constitution repeater B.

The bandwidth of each channel is 45 MHz. The centre frequencies of co-polarised transponders are separated by ▶

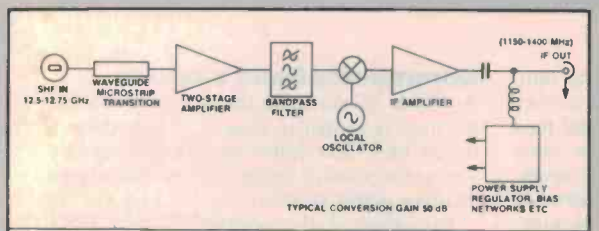


Figure 1. Typical earth station outdoor unit (low noise converter).

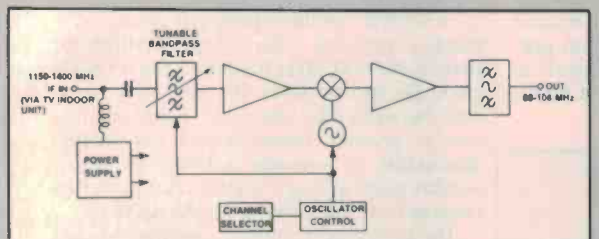
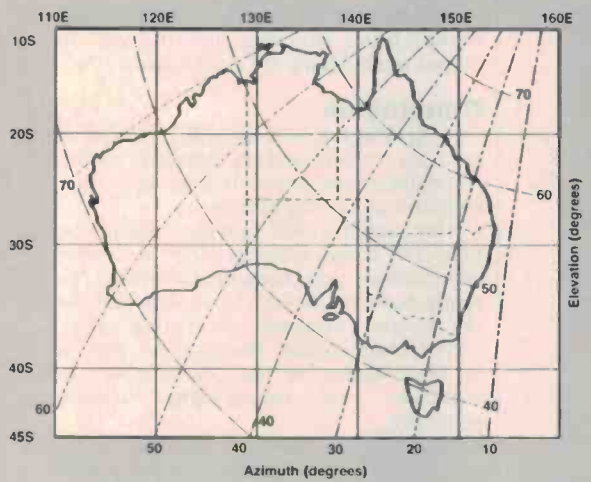
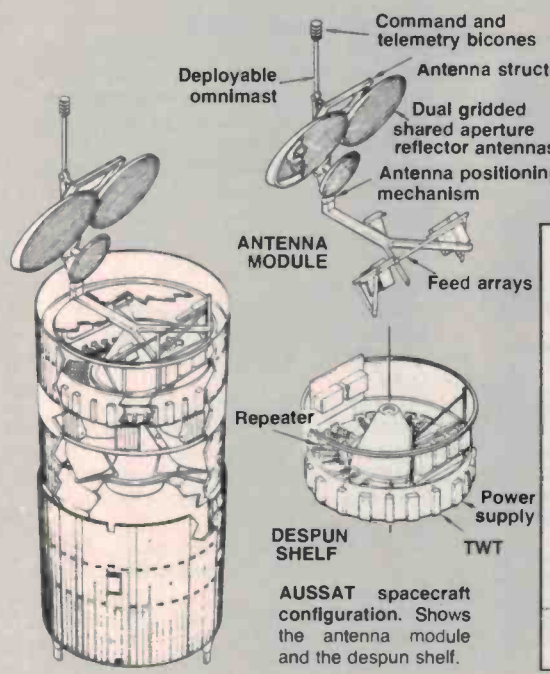


Figure 3. HACBSS single channel per carrier block translator.



Looking at the AUSSAT spacecraft. Azimuth and elevation angles from an earth station to a satellite at 160°E. The angles for the other locations will not differ from these by more than 10°.



AUSSAT spacecraft configuration. Shows the antenna module and the despun shelf.

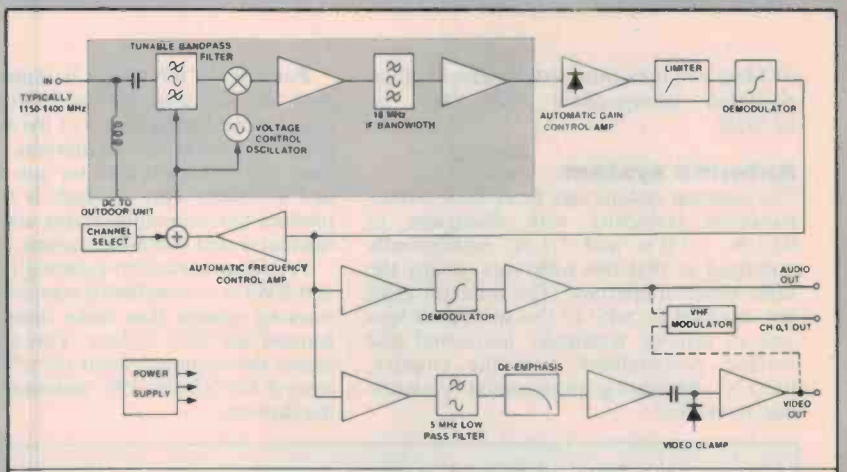
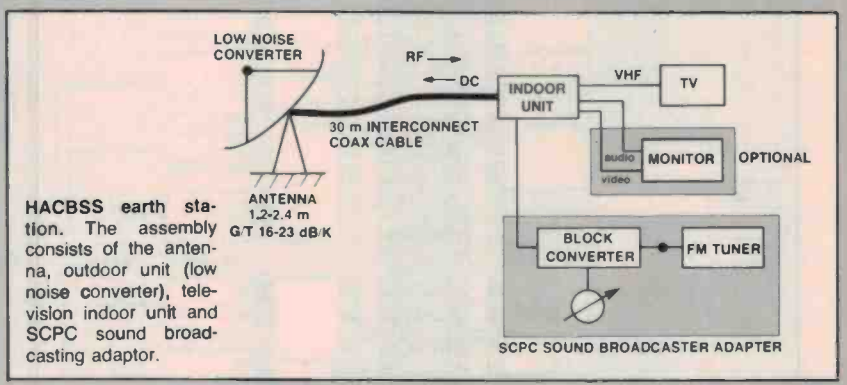


Figure 2. Typical earth station indoor unit.



HACBSS earth station. The assembly consists of the antenna, outdoor unit (low noise converter), television indoor unit and SCPC sound broadcasting adaptor.

	Repeater A Transponders								Repeater B Transponders						
Beam	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
NA	S		S	S		S	(S)								
NB									S	S		S	H	(S)	(S)
PNG				S		S		(S)							
NE									S		H			(S)	(S)
SE	S		S		H		(S)	(S)							
CA										S		S		(S)	(S)
WA		H		S			(S)	(S)							

'S' denotes switched FSS connections
'H' denotes hardwired connections
'(S)' denotes switched HACBSS connections

Table 4. Transmit beam switching capability.

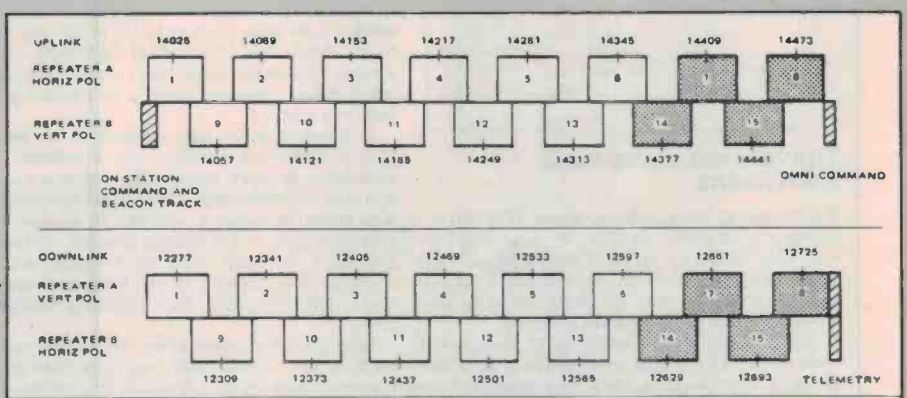


Figure 4. Frequency and polarisation plan shows the transponder centre frequencies.

64 MHz and the centre frequencies of cross-polarised transponders are offset by 32 MHz.

Antenna system

The antenna system uses three dual surface parabolic reflectors with diameters of 0.61 m , 1.0 m and 1.1 m, orthogonally polarised so that two reflectors occupy the same physical aperture. The reflector grids are oriented at ±45° to the spacecraft spin axis to provide nominally horizontal and vertical polarisations over the country, thereby minimising polarisation crosstalk due to rainfall.

Each of the ten beams is shaped to optimise the coverage of the desired service area by employing arrays of pyramidal feed horns with complex excitations. No more than four feeds are used for any one beam, and a total of only 27 feeds is required to produce the communications and tracking, telemetry and command beams.

Precision on-station pointing (±0.05° NS and EW) is accomplished using an on-board tracking system that locks onto a beacon transmitted from Sydney. This system generates the necessary error control signals to correct for NS and EW variations in pointing direction.

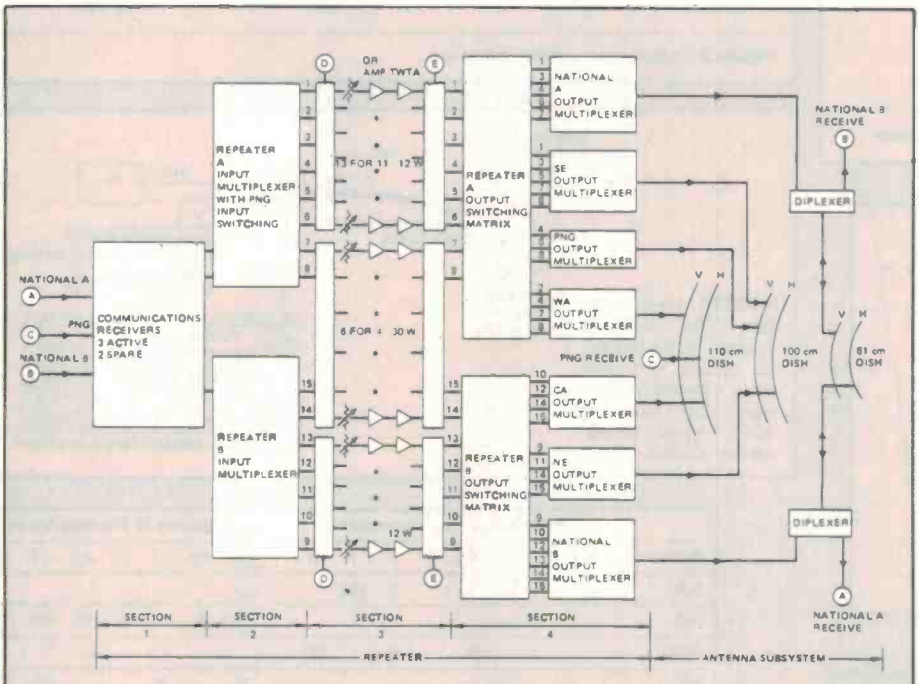
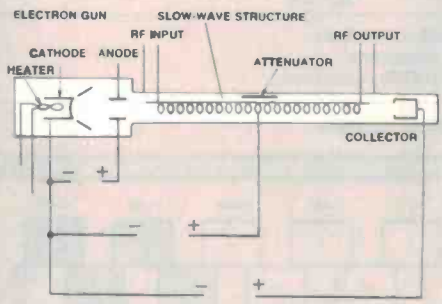


Figure 5. Block diagram of the AUSSAT communications payload.



TRAVELLING WAVE TUBE AMPLIFIERS

The travelling wave tube amplifier (TWTA) is a microwave amplifier capable of amplifying over very wide frequency bands. The amplification process takes place by continuous interaction between an electron beam and an electromagnetic wave propagating along a slow-wave structure.

The principle was invented by R. Kompfner in 1943 who used a simple wire helix as a slow-wave structure. Similar tubes were then developed and first used as microwave amplifiers in microwave relay link systems.

During the last 25 years travelling wave tubes have been developed using other slow-wave structures such as coupled cavities to provide continuous wave output powers of tens of kilowatts and pulse powers of several megawatts with power gains of up to 60 dB.

Travelling wave tubes are usefully employed from UHF to centimetre wavelengths. However, the original helix slow-wave structure is still one of the most useful due to its great bandwidth. Tubes employing helices have been made with useful amplification properties over a bandwidth greater than two octaves.

A travelling wave tube consists of an electron gun, a slow-wave structure and a collector. The slow-wave structure propagates microwave signals and has an attenuator region approximately halfway along its length to absorb RF energy which may propagate in the reverse direction. Without an attenuator the tube could be unstable and self oscillate. The collector traps the spent electron beam and dissipates this remaining energy as heat.

Most travelling wave tubes with power outputs up to a few hundred watts use a periodic permanent magnet focusing system which is lighter, more compact and has less leakage magnetic field than a uniform system.

Communications payload

A block diagram of the communications payload is shown in Figure 5. In section 1 the 14-14.5 GHz uplink signals, collected by one of the receive beams. are routed to one of three active receivers.

In section 2 the national A and PNG uplinks are routed to the repeater A input multiplexing network and the PNG switching network. National B uplinks are routed via a receiver to the repeater B input multiplexing network. The input multiplexer divides the 500 MHz band into the 45 MHz channels and provides the necessary isolation between the channels. Each channel has a ground commandable switchable attenuator to provide a range of transponder gains giving nominal saturation flux densities of −90, −85 and −80 dBW/m^2.

The high power channel amplifiers shown in section 3 consist of a solid state driver amplifier and a travelling wave tube amplifier.

Section 4 of the repeater consists of the channel/beam switching network and the output multiplexing for each beam.

Conclusion

The AUSSAT spacecraft will carry one of the most complex and operationally flexible communications payloads ever flow on a commercial satellite system.

The satellites will provide communications and broadcasting services to isolated communities and homesteads which currently have no services, and will improve the services available to existing underserved communities. The satellites provide an ideal means for the development and expansion of broadcasting services generally.

The satellite system will make it economically feasible to introduce many new communications services and will also stimulate growth in Australia's communications and electronics industry.

Acknowledgements

I would like to thank these people for their help and advice during the preparation of this article and also for supplying diagrams and photos: Dr Wayne Nowland, Space and Communications Manager of AUSSAT, and his staff; Richard Barlow of Hughes Aircraft Company, Space and Communications Group; Max Pearce, Department of Communications.

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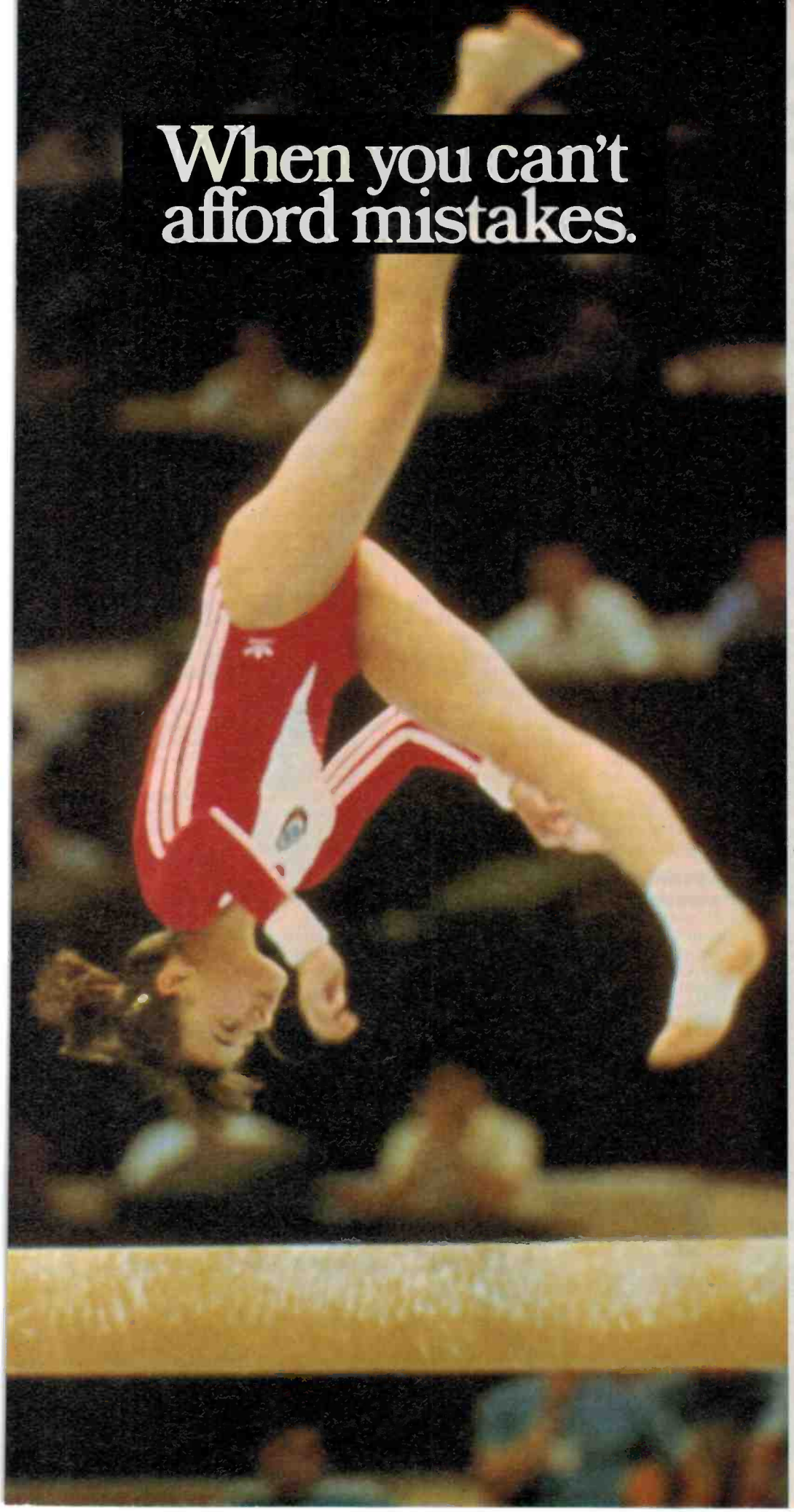

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Computers and communications

Computers and communications are convergent technologies. Modern communications, little more than a century old, have significantly "shrunk" the world and reduced barriers between people and countries. The Computers and communications (C&C) concept, expanded to a 'Man and C&C' system will be the instrument to break down the remaining barriers, particularly the language barrier. Further technological development in the fields of computers and communications will fuel a profound change in human affairs by or before the turn of the century. Dr Kobayashi intends to be there as it happens.

Dr. Koji Kobayashi
NEC Corporation, Tokyo, Japan

ELECTRONIC and optical intelligent communications incorporating an abundant computer technology must never be considered without the recognition of the importance of telecommunication networks as the infrastructures of human societies.

Modern communications has brought new possibilities even to many areas of the conventional non-electrical communications services. Of course, we have to pay attention to the fact that through modern communciations, the scope of the information flow handled by electrical communications services has been expanded, and the level at which it is handled has risen. Both the development of new communications media, and the penetration of computer technology and information processing technology into communication facilities are related to these facts and issues.

I recognised the advent of computer and communications ("C & C") systems through the merger of computer technology and communications technology as an important technological trend supporting the movement of human societies away from industry towards knowledge and information, and have spoken on the topic on many occasions over the past several years.

As an extension of this concept of "C & C" technology, I have also advocated the "Man and C & C" system concept. This is the result of directing attention to the identity and importance of software technology, which can be said to be one of two essential portions of computer technology. This is closely related to the necessity of developing easier-to-use-machines with better human interface, and to the possibility of their realisation.

I think that it is effective to positively apply the "C & C" and "M and C & C" concepts to promote and accelerate the development of modern communciations oriented to the new information society.

Technical features of modern communications

In order to define "modern communications" I will show you here our approach to the visual field and its scope which is considerably expanded from that of conventional communications.

Now let us separate the fundamental functions of modern communications into three elements in order to arrange and grasp various aspects of modern communications from the viewpoint of the merger of comptuers and communications; see Figure 1.

The first element is "to deliver information to the proper distant destination quickly and without error". This is, of course, the fundamental function of conventional electrical communications, that is, "information transfer".

The second element is "to gather and format the information to be sent in the form most easily understood by receivers" with the support of computers. In other words, "information generation".

The third element is "to store and file information for subsequent delivery to receivers", i.e: "information memory".

From a different point of view, let me examine the richness and variety of information media in the interface between modern communications systems and human beings.

The various distinct media of the information, which flows from human output organs to input organs, are listed along the ordinate axis of the matrix in Figure 2. The classification of information media will remain flexible as computer technology

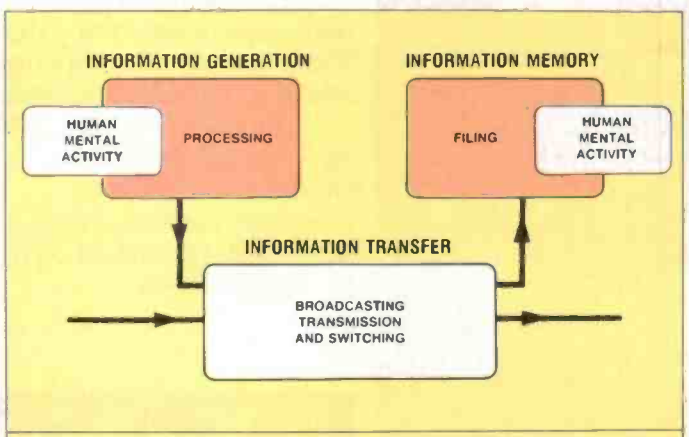

Figure 1. Relationship of modern communications functions.

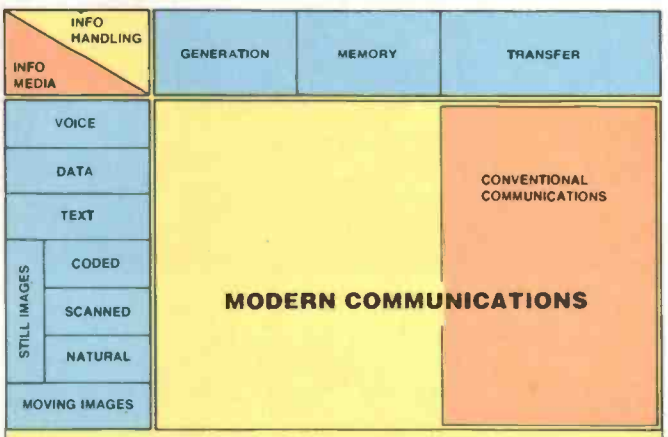

Figure 2. Function ranges of communications.

progresses. Along the abscissa of Figure 2, the three main elements from Figure 1 — information generation, information memory and information transfer — are shown. Moreover, the *scope* of modern communications, which includes conventional communications, is indicated in Figure 2.

The 'whole picture'

In the diversity of communications there are portions which can be handled by conventional communciations. In addition to these there are portions which exceed "simple information transfer" and are peculiar to the modern communications picture. In any event it is very difficult to show modern global communications system covering this wide diversity in an easily understandable drawing.

In spite of the difficulty I have ventured to try and express such systems in Figure 3. It shows domestic 'transparent' communications networks connected via various international communications networks.

Transparent communications networks have multi-layered structures containing public telephone networks, public packet networks and various leased lines. These multi-layered structures are considered to be a general trend from the viewpoint of not only service functions but also business allocations and coexistence of operating enterprises.

In comparing Figures 1 and 3, it is clear that the functions of "information generation" and "information memory" in large part correspond to the functions of various intelligent information facilities and intelligent terminals, and that the functions of "information transfer" generally correspond to various levels of the transparent communications networks.

The task of building global infrastructures

One of the important strategic policies in promoting and accelerating the building of such modern communications systems is the conscious positioning of them as "global infrastructures". In other words, it is to put emphasis, from the very start, on the realisation of international and global modern communications at the earliest possible time. Let me discuss just one of the modern communications subsystems.

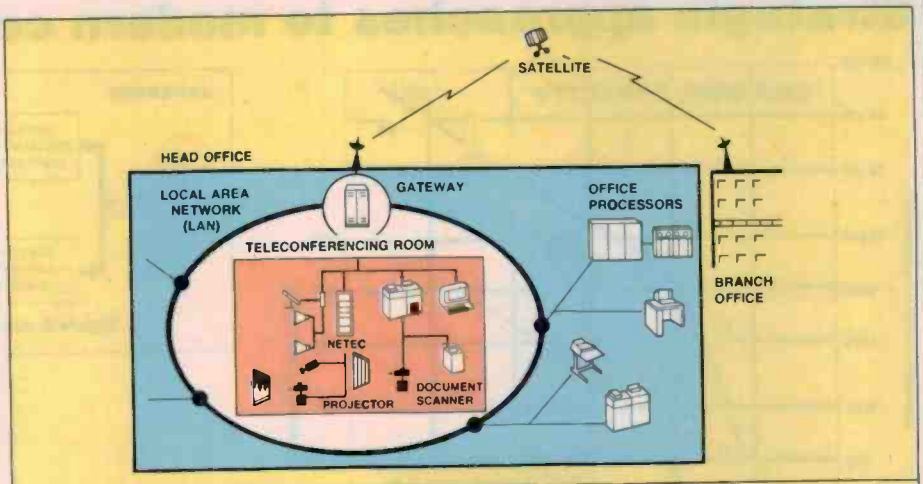

Figure 4. Teleconferencing system.

Teleconferencing Systems

Through the introduction of office automation, the efficiency of office workers is being pursued. Room for improvement can also be seen in the area of conferences or meetings. Where the offices of the conference participants are geographically dispersed, it is necessary to direct attention to the effectiveness of teleconferencing at two or more locations.

Particularly in the case of international meetings, participants generally spend long hours travelling long distances. Therefore, even partial international teleconferencing is very attractive for such occasions.

In order to improve the efficiency of the conference, the fundamental principle is to enable participants to convey their ideas or thoughts to others accurately, in a short period of time. For this purpose, in addition to numeral and letter or character information, effective use of visual information including facial expressions and gestures, should be emphasized. Figure 4 shows the conceptual outline of the teleconferencing system.

There are four main tasks in building the international teleconferencing system:

1. Since in teleconferencing many terminals will use wide bandwidth transmission lines simultaneously for long periods of time, efficient bandwidth use is important.

2. Efficient system conversion technology for different TV standards must be developed.

3. In teleconferencing there will be cases where one language has to be interpreted simultaneously and automatically into several languages. In addition to automatic interpretation, it will become necessary to automatically translate the words or sentences in the materials presented to the conference.

4. Reduction of the time required for real time teleconferencing is one of the measures that must be taken. To accomplish this, we must provide powerful support for real time teleconferencing by utilizing the non-real time teleconferencing techniques such as audio/video recording and processing technology.

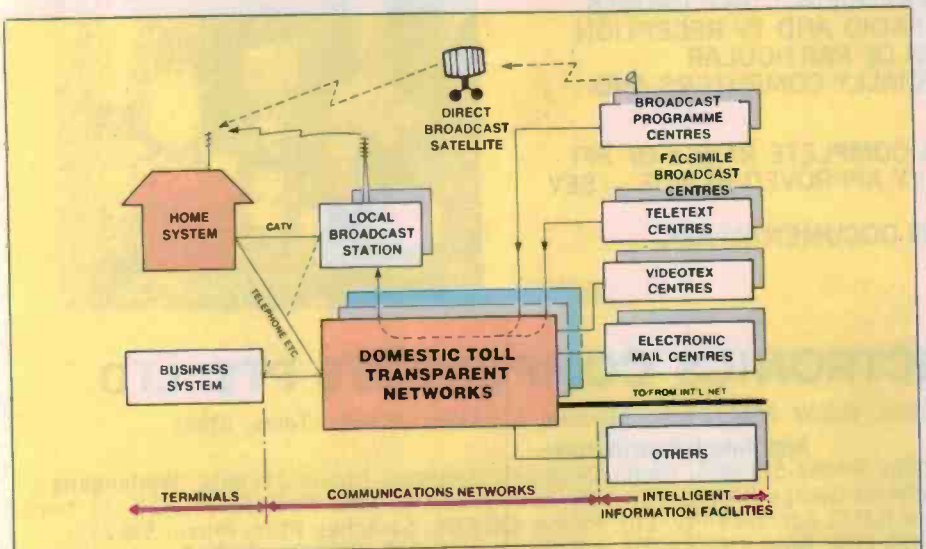

Figure 3. Global view of modern communications.

Tasks of international cooperation and exchange

One other important strategic policy concerning modern communications systems is the promotion of international cooperation and exchange in this field. This means that we tackle a task which will serve as a stepping stone for developing successively modern communications systems on a worldwide scale.

Let me pick up the case of joint international use of satellites. ▶

Dr Kobayashi is Chariman of the Board and Chief Executive Officer of NEC Corporation. **This article has been condensed from the text of a paper he gave at the 4th World Telecommunications Forum at Geneva, Switzerland, in October, 1983. We are indebted to NEC, through Nielson McCarthy McFarling & Co, for their kind permission to present this material.**

Strategic approaches to modern communications

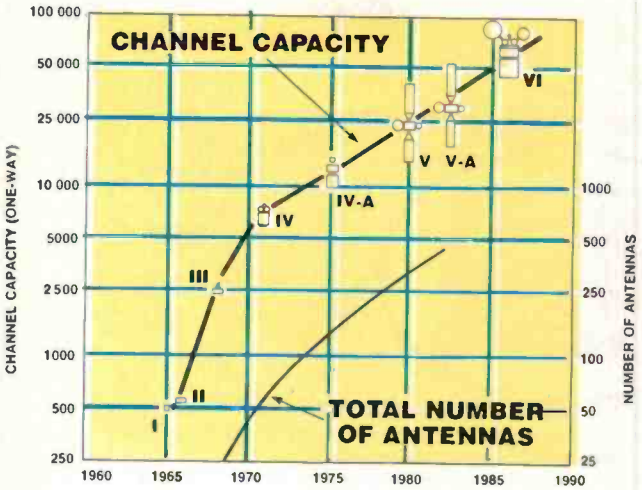

Figure 5.
Intelsat system.

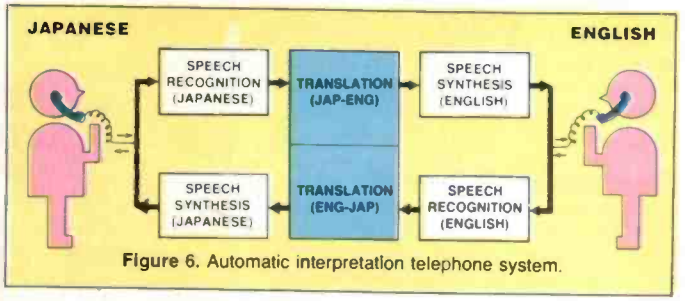

Figure 6. Automatic interpretation telephone system.

The remarkable development of the INTELSAT system has splendidly embodied the hopes placed on outer space by mankind. This is also a product of the wisdom of mankind aimed at international cooperation and technological progress. Figure 5 shows the truly impressive growth of the INTELSAT system.

INTELSAT opened the way for domestic communications, in addition to international communications, when it started transponder lease service in 1975. Since then, the number of countreis utilizing the service has mounted to twenty. In order to respond to new, worldwide, demands for satellite communications applications such as business communications, teleconference, and thin-route services are planned. These all derive from international cooperation, and support for common use.

In addition to those satellites already mentioned, there are the Indonesian Palapa satellites already in use by ASEAN countries, the European ECS launched last June, and the ARABSAT regional satellite to be launched in the near future. These are clear examples of the expanding international shared use of such satellites.

This will bring about not only international friendship, but also distinct advantages to economy, culture and education. This trend is also quite desirable from the internationally accepted viewpoint of effectively utilizing both geostationary orbits and frequency spectrum.

Meteorological satellites

Among the various types of satellites in international use, the meteorological observation satellite is the most typical example of international cooperation in modern communications.

The meteorological information gathered by these satellites is not only sent around the globe to aviation and marine users, but also has become a part of everyone's daily life in the form of weather forecasts on TV and in newspapers. The information is also widely used for the study of long-term worldwide meteorological changes and the prediction of the courses of typhoons.

The information from the geostationary meteorological satellite "Himawari" launched by Japan is utilized by fifteen

countries in Oceania and Asia, including Australia, Singapore, Thailand, the Philippines, China and Korea for their meteorological activities.

The use of artificial satellites is not limited to those mentioned thus far. Their utilization will increase in many fields such as surveys for natural resources and explorations of planets, to name but two. At the same time they are furthering both closer international cooperation and the usefulness of space.

The infinite reaches of space provide mankind with unlimited dreams for the future and places for challenges. In order to realize these dreams, the ever increasing importance of international cooperation on a worldwide scale is clearly seen.

Conclusion

I have presented my view of modern communications as one aspect of the overall functions of Computer and Communications ('C & C'), and have discussed some problems surrounding strategic approaches. Modern communications comprises systems which combine computer functions in the broad sense with conventional communications. I have presented a bold, overall picture of modern communications systems as global infrastructures crossing national and geographical borders.

Specific tasks in our strategic approaches have been indicated, stressing the importance of tasks aimed toward developing systems for international modern communications.

I examined some steps aimed at developing international cooperation and exchange which are not only useful, but also necessary for building modern communications systems.

As you can guess from the foregoing discussions, the advances in microelectronics, optoelectronics and computer technology have thoroughly changed the concept of conventional communications. When we think of the influence modern communications will exert on the development of the culture, civilization, industry and economy of mankind, it will exceed by far the great progress made during a little more than one century since the advent of conventional communications or marked over the 118 years since the start of the ITU or more precisely, from its predecessor the Telegraph Union.

Giving thought to the changes in world societies and economy that modern communications are exercising, I feel a heavy responsibility as a person engaged in this field. I always have great respect for the achievements of the International Telecommunication Union, which has spent more than one century in the development of world communications, particularly as regards international cooperation and exchange.

It is my earnest wish that the ITU wil further promote the steady establishment of technological standards with firm perspective, and that it will realize new developments by promoting the actualization of more effective, high-grade utility and operative systems of modern communications, in order to establish the new world communications order of a new era.

Incidentally, I feel the world today still lacks the mutual understanding necessary among the peoples of different nations. Japanese in particular feel that linguistic differences are a major barrier. The languages of different peoples must be respected.

In this regard, I believe that the development of automatic interpretation systems will be one of the indicators for the realization of the 'C & C' concept. Fortunately, we at NEC have at our disposal sophisticated voice recognition and synthesis technologies that we have developed over the past 20 years. And we have supplied voice recognition equipment and speech synthesis equipment to the world market for several years. We hope that by wedding these technologies to techniques for sentence analysis we will hopefully be able to achieve the dream of automatic interpretation. If this is realized, English spoken by you would reach me in Japanese, and my own thoughts would be interpreted and transmitted to you. Figure 6 depicts the procedures involved.

I have personally witnessed how ideas for a new technology, be it pulse code modulation, geostationary satellites, or even optical-fibers, were brought into practical use through nearly 20 years of human effort. For this reason I am confident that automatic interpretation systems will also be realized before the coming of the year 2000. I have made it my life goal to be able to confirm for myself, with my own eyes and ears, the coming of that day. I find myself encouraged in my efforts by the thought that this marvellous technology will be the greatest gift that 'C & C' can bring mankind. ●

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SINGLE USER, MULTI USER, OR MULTI-PROCESSING. Or buy a single user system now and expand it later. No matter how you buy it you can't buy more performance for less. UNLIKE "TOY" COMPUTERS OUR SYSTEM CAN BE EXPANDED WITH HIGH-RES COLOUR GRAPHICS, MEGABYTES OF MEMORY, VIDEO DIGITIZERS, A/D-D/A CONVERTERS, IEEE-488, VOICE INPUT/OUTPUT, UP TO 256 PARALLEL OR SERIAL I/O PORTS, MUSIC SYNTHESIZERS, AND IS SUPPLIED AS STANDARD WITH CP/M, GIVING ACCESS TO A MASSIVE SOFTWARE LIBRARY INCLUDING OVER 100 VOLUMES OF PUBLIC DOMAIN SOFTWARE.

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This allows you to expand the basic system with a 16 bit 8088 processor module. Using our exclusive software it is then possible to switch under software control between CP/M 80 and CP/M 86. Coming soon MS/DOS operating system to provide IBM/PC compatibility.

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The system can be expanded with slave processor modules. These modules provide a Z80A processor (optionally Z80B) two serial ports, two parallel ports, 128K of RAM and real time clock. In this way up to 16 users can share the system's resources and achieve the kind of throughput previously only possible with mini-mainframes. CP/M PLUS (VERSION 3.0) NOW AVAILAble for an additional $350. For 10 Megabyte Hard Disk add $200.

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TM700

The TM703 and TM705 5¼" high performance Winchester disk drives feature closed-loop positioning. The on-board microprocessor calculates the optimum positioning algorithm, yielding an average access time of 39 milliseconds maximum. Their high capacity makes them ideal for small desktop computers.

TM703 and TM705 feature:

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- Rotary voice coil positioning.
- Quality intensive, conservative design.
- Plated media.

TM700 SPECIFICATIONS

	Now Available! TM703	Available Soon! TM705
CAPACITY		
Unformatted Storage Capacity:	30.1 megabytes	50.1 megabytes
Number Data Surfaces:	5	
Bytes Per Track:	10,416	
Track Density:	600 TPI	1000 TPI
Cylinders:	578	962
ACCESS TIME		
Seek Track-to-Track Access Time, Including Head Settling Time:	5 milliseconds	
Average Seek Time, Including Head Settling Time:	39 milliseconds	
Maximum Seek Time:	65 milliseconds	
Average Latency:	8.33 milliseconds	
Disk Rotational Speed:	3600 RPM	
Data Rate:	5 megabits per second	
RELIABILITY		
MTBF:	11,000 power-on hours	
Preventative Maintenance:	none required	
MTTR:	30 minutes	
Average Component Life:	5 years	
Error Rates:		
Soft Read:	1 in 10^{10} bits	
Hard Read:	1 in 10^{12} bits	
Seek Errors:	1 in 10^{6} seeks	
ELECTRICAL REQUIREMENTS		
+5 Volts D.C. Power	+5 volts ±5% at 0.8 amperes typical at 50 millivolts PARD maximum	
+12 Volts D.C. Power	+12 volts ±10% at 1.5 amperes typical at 50 millivolts PARD maximum	
DIMENSIONS (EXCLUDING FRONT PANEL)		
Height:	3.25"/82.55mm	
Width:	5.75"/146.0mm	
Length:	8.0"/203.2mm	

Specifications subject to change without notice. (5/83)

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IT'S READY-SET-GO FOR THE PERTH ELECTRONICS SHOW!

Claimably the largest consumer electronics show in Australia is held annually in Perth during the first week of August.

This year's show will be held over the 1st to 5th August, once again in the Agricultural Society showgrounds in suburban Claremont. Most of the biggest names in the industry will be there, along with a host of other well-known firms.

Over 90 firms exhibited at last year's show and some 80 organisations, large and small, have already booked to be there this year.

The organisers claim almost 100 000 people paid to attend last year's mammoth bash, the fifth they've held, and the biggest to date. The organisers, the W.A. Consumer Electrical & Electronics Association, expect that record to be exceeded this year by a considerable margin as the show has grown in leaps and bounds since its inception. (A review of the 1983 show appeared in the September '83 issue of ETI, page 12).

Who'll be there in August? Well, you'll be able to see goodies from AWA-Thorn, Rank-NEC, Sony, National Panasonic, Sharp, Roadshow Home Video, Prestige Video, Eurovox Car Sound, Futuretronics, Hitachi, CBS, Marantz, Philips, Applied Technology, AIWA, Tandy, Lowrey, Sanyo, Commodore Computers, John Sands-Sega Computers, Apple, Telecom, Ultronic Industries, Pioneer, Toshiba, Arena Distributors, Convoy International, JVC, Bose and Warburton Franki — to name just a few familiar faces.

On-show will be everything from home computers to home security systems, compact disc players to computers and computer games, TV antennas to audio systems.

Last year, many major films exhibited equipment that was not released here until the first quarter this year. It is expected the same will happen at this year's show which makes it a fantastic opportunity to get a hands-on preview of all the Christmastime and 1985 releases.

Naturally, ETI is going to be there this year. We'd like to see you there. Join us at the 1984 Perth Electronics Show, 1-5 August.

ORION VCR

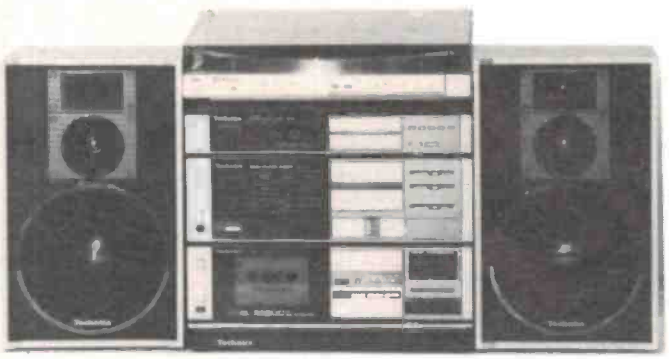
Ultronic Industries has released the Orion VH-3 video cassette recorder which has a recommended retail price of $899.

It is front loading with an infrared remote control to change the channels. Features include a 14-day, four programme timer with provision for every day use, cue and review, fast forward/rewind and slow motion frame advance.

Ultronic Industries has also released the Garrard compact disc player, priced at $599.

The Garrard CD player features music search, memory function, fast forward/reverse and has a multifunction indicator to show the status of operation.

For information contact **Ultronic Industries (Australia) Pty Ltd, 338 Kent St, Sydney NSW 2000. (02)29-4881.**



TINY TECHNICS

The Technics 315 Series hi-fi components are a tiny 315 mm each, the size of an LP record jacket cover.

In the two systems, Series 44 and Series 66, a direct connector system links all the components (except the turntable) directly via built-in connectors, thus eliminating wires.

Series 66 has 'direct operation' which gives the choice of operating any source i.e: tuner, tape deck, turntable or graphic equaliser; amp input selector will change automatically.

The Series 66 system includes the SU-6 stereo integrated amplifier, ST-8 synthesiser FM/AM stereo tuner, RS-6 two-motor dbx equipped cassette deck, SL-D4 direct drive linear tracking turntable, SB-F66 three-way linear phase speaker system, SH-E4 stereo graphic equaliser (optional), SL-P7 compact disc player (optional) and the SJ-726 desk-top audio rack.

The Series 44 system includes the SU-4 stereo integrated amplifier, ST-4/S FM/AM stereo tuner, RS-4 soft-touch cassette deck, SLD-4 direct drive linear tracking turntable, SB-F44 two-way linear phase speaker system, SH-E4 stereo graphic equaliser (optional) and the SH-726 desk-top audio rack.

For more information contact **National Panasonic (Australia) Pty Ltd, 95 Epping Rd, Nth Ryde 2113 NSW. (02) 887-5333.**

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Computers and Computing Volume 4 is packed solid with reviews, projects, programmes and information. It's just about enough to toggle your input port at its maximum baud rate! Available now at your newsagent or through ETI Booksales this book is a must for anyone who is serious about Computers and Computing.
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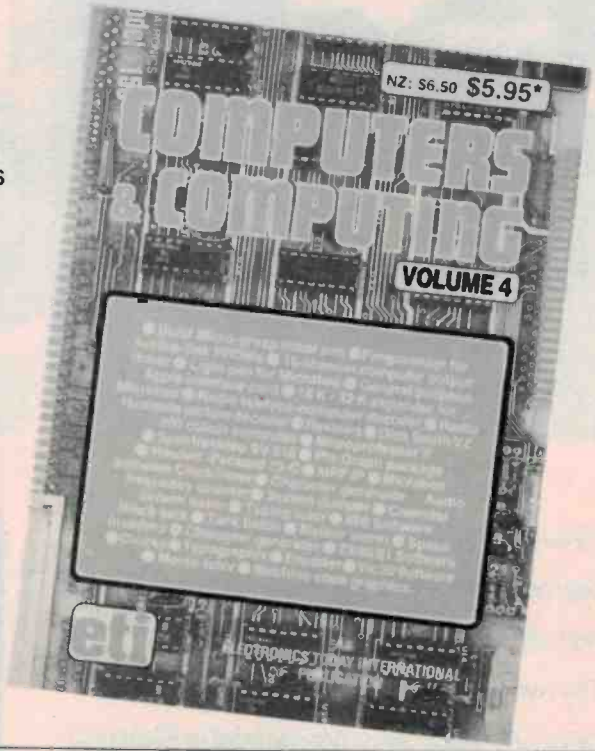

HI-TECH COMES HOME!

1984 never looked so good!
Electronic Lifestyle is the magazine for 1984! It brings you right up to date with what's happening in Video, Hi-Fi, Computers, right down to the terms you'll be using in this electronic lifestyle. Make it your 1984 Yearbook. Available from your newsagent or from ETI Booksales, 140 Joynton Avenue, Waterloo 2017. Please add $1.75 post and packing when ordering.

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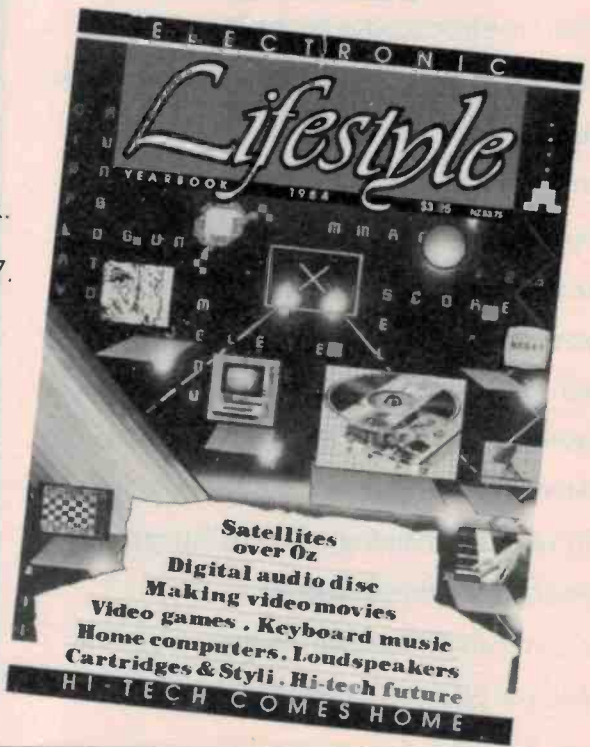
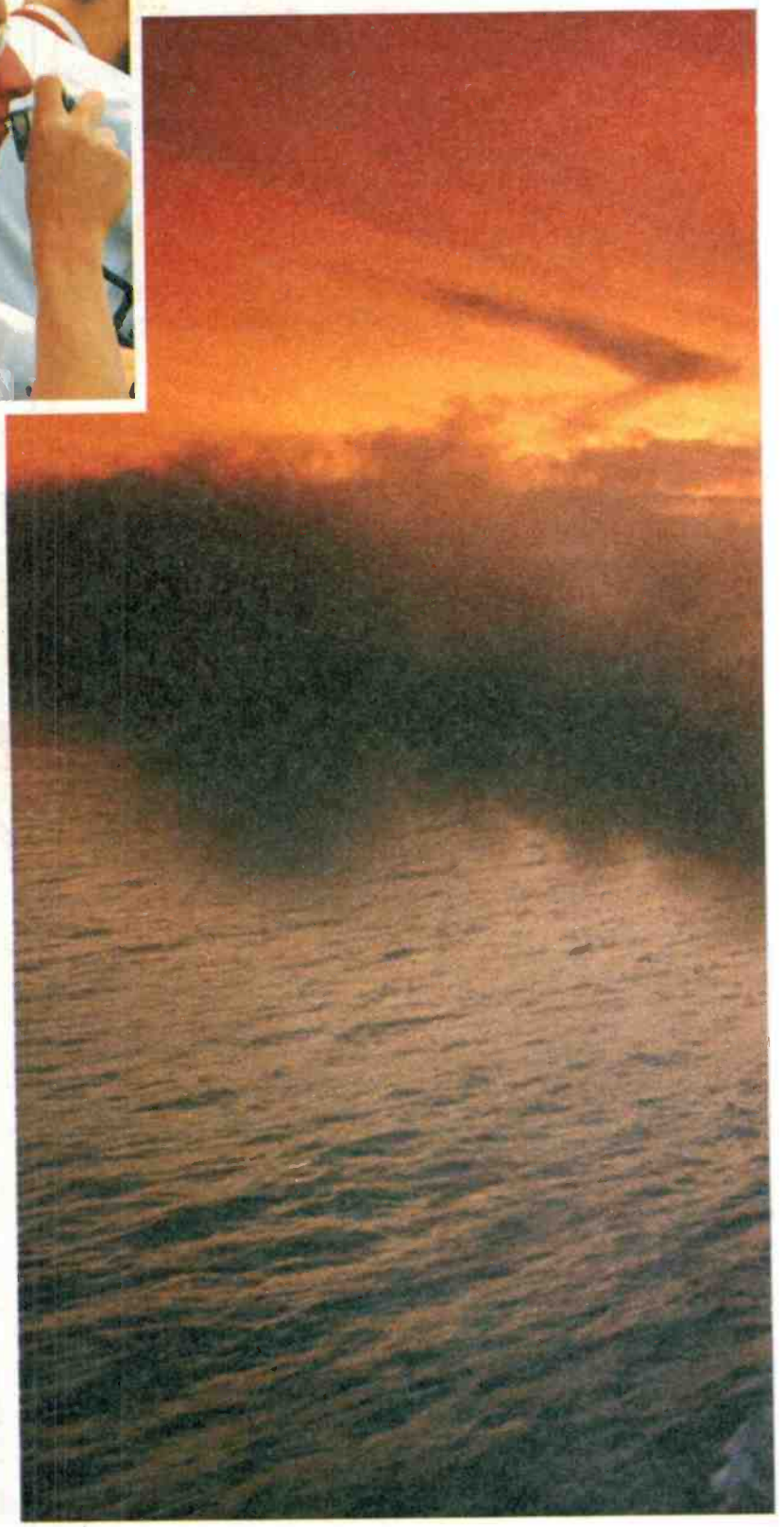


Straight sail



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The Navy is seeking university entrants in the fields of Science, Arts, Mechanical or Electrical Engineering to attend the Royal Australian Naval College and the new Australian Defence Force Academy.

If you have matriculated or are currently undertaking your matriculation, are an Australian citizen or eligible to apply for Australian citizenship, are under 20 on the 1st January of your intended year of entry and are able to meet our selection requirements you will be offered excellent pay to obtain the degree of your choice and qualify as an Officer in the Navy. Taking up positions such as Combat Systems Officers, Marine Engineers, Seaman Officers and Supply Officers. Commanding men and playing a key role in the defence of Australia.

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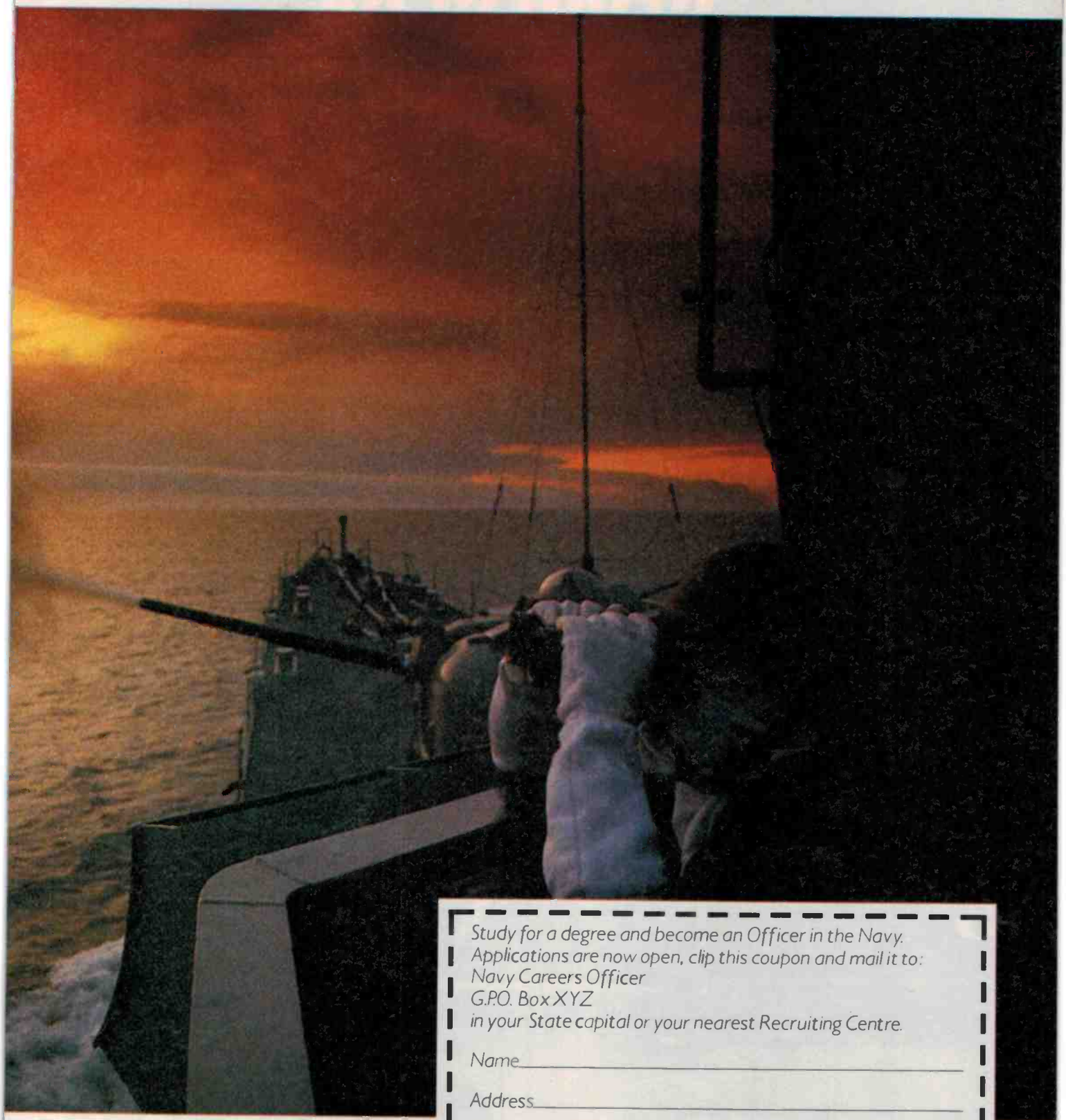
Are you good

ing through a degree course.



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enough?

The audio giant scores 10 out of 10.

System 330 Hi-Fi Component System.

1 A full 35 watts RMS/channel power, drives the system's stereo units, delivering life-like sound through 3-way speakers.

2 Servo-controlled motor with belt drive assures constant, accurate speed. Cue control on turntable gently lowers tonearm into groove, preventing possible damage to the record or the stylus.

3 Built-in 5-band graphic equalizer enables you to custom contour the system's sound at 5 critical points along the audio spectrum by as much as 10dB.

4 A/B speaker switching enables you to connect two sets of speakers to your system and listen to them separately or together.

5 The tuner with its 3-segment LED signal strength indicator lets you know when you're receiving a weak or distant station.

6 Two 5-segment LED VU meters on the cassette deck provide precise, easy-to-read record levels and help to prevent distortion.

7 Dolby* noise reduction circuit minimises distracting tape hiss and allows you to record and playback crisp, clean sound.

8 3-way, 3 speaker systems each containing 25cm woofer, 10cm midrange and a 2.5cm dome tweeter.

9 Audio component rack with attractive wood-grain finish includes record storage facility. Castors for easy mobility, glass door and hinged glass turntable dust cover.

10 The tenth feature is the price and Sanyo has taken care of that too, but that's life.

*Dolby is a registered trademark of Dolby Laboratories.

SANYO

That's Life!

7225

NAD 5200 compact disc player

A well designed 'no-frills' unit with simple controls. An extremely good performance with an outstanding ability to track means that this player would be suitable in either a home or a broadcasting studio.

Louis Challis

IN THE RELATIVELY short period since the official release of the first CD players by Philips and Sony, there appears to be three basic classes of compact disc players emerging from Japan and Europe. The first class is what may be described as 'first generation' machines, typified by the Sony CDP 101 or the Technics SL-P8, which have an excellent performance supplemented by either standard or optional remote control capabilities.

The second class appears to be the most expensive machines, typified by the latest Sony CDP 701ES and the Yamaha CD1. This class of CD player provides almost everything that 'opens and shuts' with a price tag to match.

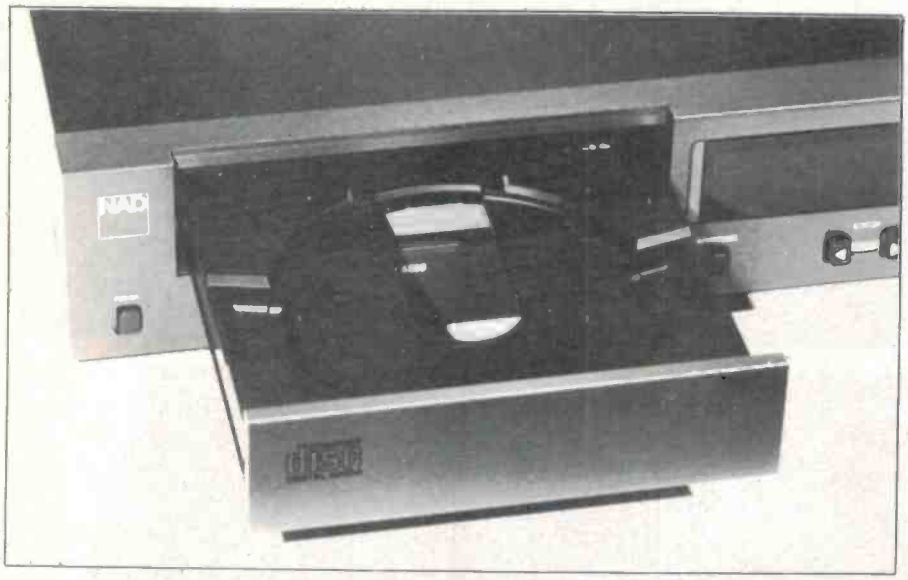
The third class consists of the more basic machines; most of them cost a little less than their illustrious brothers but do not seem to offer any significant reduction in audible performance or quality as a result of the skimpings or savings in manufacturer's costs.

It should be noted that in the last few months most manufacturers of CD players have introduced various forms of value engineering, such as the development of special integrated circuits, to achieve a more acceptable and realistic price structure.

Now that shops have adequate numbers of players available to sell the public is becoming aware that the differences between CD players are not in direct proportion to their selling price. This will ultimately mean that the designers and marketing personnel have to offer 'something different' to attract the purchaser's eye.

While most of the marketing personnel have been pushing fancy automatic programme selections and even special display capabilities, a small but growing number of manufacturers have realised that what most of the public really wants is a 'no-frills' machine with the best possible performance commensurate with price. ▶

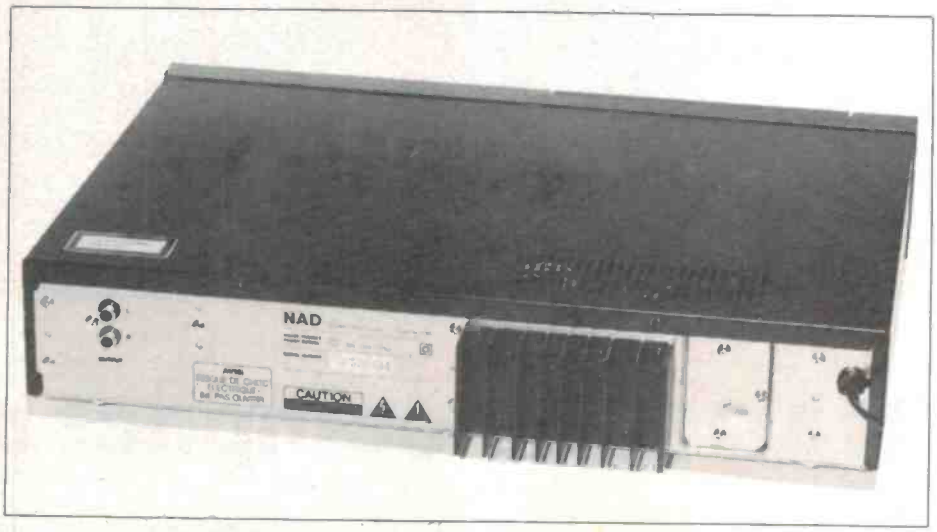
SOUND REVIEW



NAD 5200 COMPACT DISC PLAYER

Dimensions:	*420 mm wide x 86 mm high x 335 mm deep*
Weight:	*6 kg*
Price:	*Rrp $969*
Manufactured:	*In Japan for NAD Electronics, London.*
Distributor:	*The Falk Electrosound Group, 28 King St, Rockdale NSW 2216. (02)597-1111.*

The NAD 5200 compact disc player is just such a machine and, for a variety of practical reasons, the marketing personnel at NAD are describing this machine as a second generation CD player.



Features

The first thing that strikes you about this machine is the simplicity of the front panel which features a minimum number of controls. The front panel is finished in satin-soft steel grey, offset by attractive white silk-screen lettering. The disc loading tray is located at the left-hand side at the top with the main display function escutcheon located immediately to its right. The controls consist of a power switch on the left with an 'open/close' button on the right and below the disc loading tray.

The operational controls consist of seven buttons, six of which are relatively small and located on the bottom right-hand side of the front panel. The first of these controls is a pair of 'search' buttons for fast forward or fast reverse, similar to the fast forward or fast reverse on a tape recorder. However, unlike the tape recorder these also offer the simultaneous ability to hear the recorded signal so that you can find a particular section on the disc.

A pair of 'skip' buttons allows you to index forward or backward with the number of tracks jumped corresponding to the number of times you touch the button. Thus, if you touch it ten times and the disc contains ten tracks, the disc will automatically find the start of the tenth track. If you press it 11 times, it will automatically recycle to track number one.

As we have a test disc with 100 tracks we were able to confirm that the function works quite happily up to 100 times, and will also display the correct track number on the display panel above.

The other controls are a 'pause' and a 'reset' button which doubles as a stop button so that you can cancel any operational instruction. The last control is an elongated 'play' button which will also close the disc loading tray to simplify the use of the unit.

The display panel uses a dual blue and green fluoro-scan display which shows DISC IN when the disc is in, READY when the disc is ready and displays the track number, index number and time in minutes and seconds elapsed during the playing of that number. The display also shows PLAY if the laser tracking element is playing, PAUSE if the unit is in the pause mode and STOP if you press 'reset'. The DISC IN and PLAY displays flash during the loading cycle until such time as the control circuitry locks in to the correct tracking mode.

The rear of the unit is relatively simple with only a pair of output sockets, a heat-sink and a double insulated power lead complying with the latest Australian electrical wiring standards.

Circuitry

Inside the CD player the designers have divided the chassis into two main areas. On the left-hand side is the CD disc-loading well with the laser tracking, demodulating and mechanical drive system at the front and the power supply at the rear.

On the right-hand side of the chassis is the main electronic circuitry using one large motherboard in which there are many large scale integrated circuits and four minor printed circuit boards, two of which are associated with the display circuitry which also uses large scale intergrated circuits to minimise the circuit complexity.

Although there are more than a few ribbon cables and wires floating around, most of these are required for interconnecting other circuit boards. In general terms, this unit has a smaller number of internal circuit boards than other comparable units which we have seen; this is primarily the result of the availability of a new generation of specially designed large scale integated circuits. ▶

HI-TECH C

An Australian developed Z80 C Compiler that runs rings around the opposition.

Features:

- Compiles Full V7 C — including enums and structure operations
- Produces fast, compact code — outperforms all competitors
- Complete I/O library
- Source for libraries included — no royalties
- Easy to use — one command compiles, assembles and links
- Powerful debugging tool included
- Command line I/O redirection
- FAST floating point
- Locally developed and supported
- Supports ROM-based software
- Includes MACRO assembler, linker and librarian

System Requirements:
Z80 CPU
56Kb RAM
200Kb Disk space
CP/M 2.2
or any UNIX system

Disk formats:
8" SSSD
* Kaypro
* Osborne
DEC Rainbow
Others: enquire
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Compiler — limited support	$125
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Manual only (refundable)	25
P & P	7

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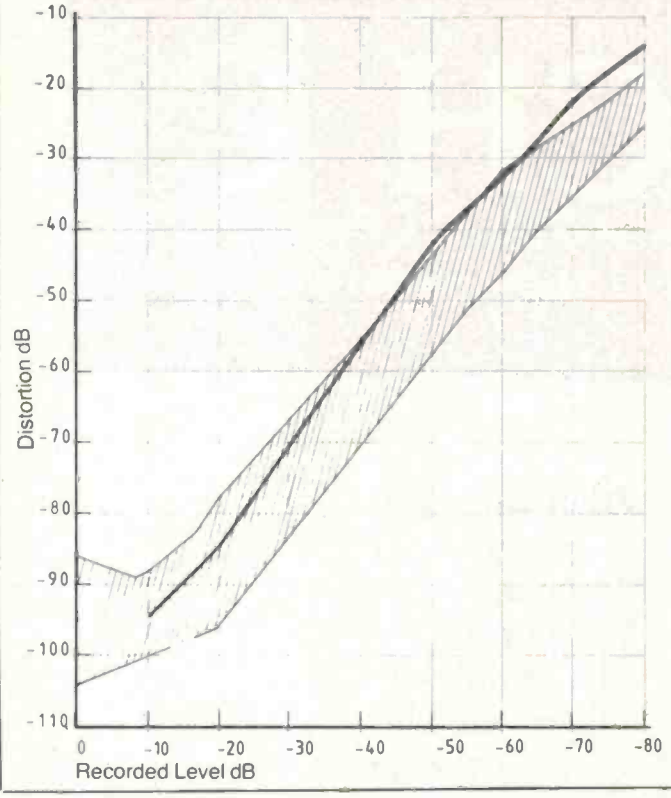
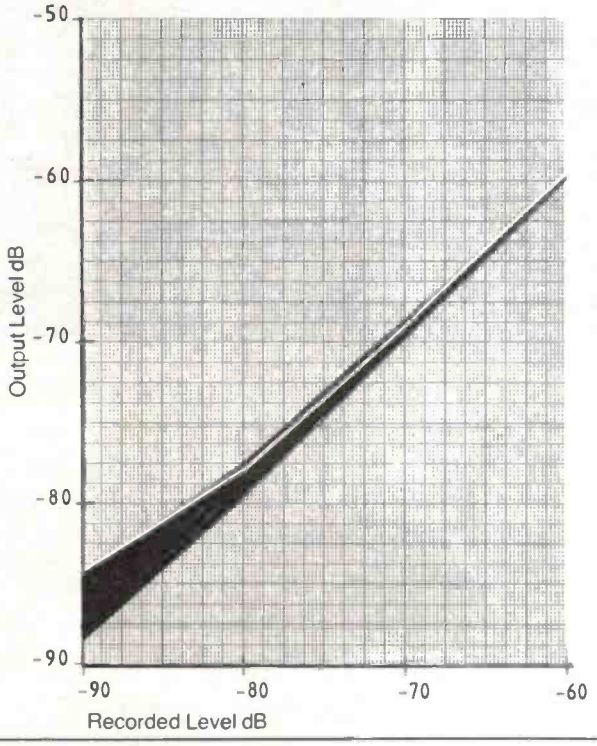
RANGE OF TOTAL HARMONIC DISTORTION
FOR SIX C.D. PLAYERS OVER THE RANGE 0 to −80 dB.



LINEARITY FOR SIX DIFFERENT C.D. PLAYERS
OVER CRITICAL RANGE −60 TO −90 dB.



MEASURED PERFORMANCE OF NAD MODEL 5200

Serial No. 3Z550034

FREQUENCY RESPONSE

FREQUENCY	OUTPUT LEVEL dB
1.0kHz	0.0
20Hz	-0.2
40Hz	-0.1
100Hz	0.0
200Hz	0.0
500Hz	0.0
1.0kHz	0.0
5.0kHz	-0.0
7.0kHz	+0.1
10.0kHz	-0.1
16.0kHz	-0.2
18.0kHz	-0.3
20.0kHz	-0.5

LINEARITY

RECORDED LEVEL dB	OUTPUT LEVEL dB
0.0	0.0
-1.0	-1.0
-3.0	-3.0
-6.0	-6.0
-10.0	-10.0
-20.0	-20.0
-30.0	-30.0
-40.0	-40.0
-50.0	-50.0
-60.0	-59.8
-70.0	-69.3
-80.0	-77.9
-90.0	-84.6

SIGNAL TO NOISE RATIO

Without Emphasis	92.0dB(Lin) 98.0dB(A)
With Emphasis	95.0dB(Lin) 101.0dB(A)

CHANNEL SEPERATION

FREQUENCY	RIGHT INTO LEFT dB	LEFT INTO RIGHT dB
100Hz	-89.2	-92.8
1kHz	-92.5	-93.7
10kHz	-86.2	-82.2
20kHz	-79.8	-75.7

DISTORTION

AT MAXIMUM OUTPUT LEVEL = 0dB

	100Hz	1kHz	10kHz	
2nd	81.7	84.8	90.9	dB
3rd	80.9	88.0	out	dB
4th	90.5	90.4	of	dB
5th	90.3	91.3	Range	dB
T.H.D.%	0.013	0.0081	0.0028	%
T.H.D.dB	-77.7	-81.8	90.9	dB

AT INDICATED LEVELS FREQUENCY = 1kHZ

	Level = - 10dB	Level = -20dB	Level = -30dB	Level = -60 dB	
2nd	-	-89.1	-	-	dB
3rd	-100.4	-90.4	-43.1	-34.3	dB
4th	-98.0	-92.4	-	-	dB
5th	-102.1	-90	-50.3	-38.9	dB
T.H.D.(%)	0.0018	0.0061	0.76	2.24	%
T.H.D.(dB)	-95.0	-84.3	-42.4	-32.5	dB

	Level = - 70dB	Level = -80 dB	
2nd	-	-	dB
3rd	-22.9	-17.4	dB
4th	-41.5	-	dB
5th	-34.6	-19.3	dB
T.H.D.(%)	7.48	17.3	%
T.H.D.(dB)	-22.6	-15.2	dB

EMPHASIS

Frequency	Recorded Level	Output Level (Left)		Output Level (Right)	
1kHz	-0.37dB	-0.4	dB	-0.4	dB
5kHz	-4.53dB	-4.6	dB	-4.5	dB
16kHz	-9.04dB	-9.1	dB	-9.0	dB

I.M. DISTRORTION

With Test Signals of 19kHz + 20kHz mixed 1:1

INTERMODULATION DISTORTION -81.8 dB

FREQUENCY ACCURACY +0.5 Hz for 20kHz test signal

Performance compared. Harmonic distortion and linearity performance of the NAD 5200 player compared to the performance range of six CD players we reviewed last year. Whilst the NAD's performance in these two areas is much the same as the players reviewed earlier, its tracking performance proved definitely superior.

One of the features which the designers claim places this unit in front of many of its competitors is the incorporation of a new generation of digital-to-analogue decoding circuits. They are claimed to produce the analogue audio signal with a significant reduction in distortion.

Objective testing

The objective testing of the NAD 5200 revealed characteristics which were generally extremely good. The frequency response is flat within ±0.3 dB to 18 kHz and is only 0.5 dB down at 20 kHz. The linearity is particularly good with flat linearity down to −50 dB. However, the transfer characteristics, displaying the normal (expected) non-linearity at lower signal levels, are 0.2 dB high at −60 dB, 2.1 dB high at −80 dB and 5.4 dB high at −90 dB. These non-linearities are unlikely to be audible except on the very lowest signals where, if you listened carefully, you might be able to just pick the difference in sound quality.

The distortion characteristics at 0 dB are particularly good, bordering on perfect at all frequencies other than 100 Hz where the distortion is still only 0.013%. At 1 kHz the distortion is still extremely good all the way down to −50 dB but rises to 2.24% at −60 dB, a moderately high 7.48% at −70 dB and a particularly high value of 17.3% at −80 dB. This distortion figure at the −80 dB level is out of keeping with the claims made in the manufacturer's pre-release publicity and is the highest value of distortion we have yet measured.

With the available software it is relatively hard to measure intermodulation distortion; the three current suppliers of testing software do not seem to realise that the intermodulation test signals should be directed to measure the characteristics of the machine at signal levels at least 50 dB below 0 VU (or peak recording level). The NAD 5200 produces intermodulation distortion products that are −81.8 dB relative to the recorded signal level which doesn't really mean anything in terms of the way the equipment operates with real signals. In a similar manner, the frequency accuracy of the player was found to be ±0.5 Hz of a recorded signal when the accuracy was only claimed to be ±2 Hz.

The emphasis and de-emphasis circuits are extremely precise with almost immeasurable deviations from the recorded signal levels. The channel separations are exceptionally good to 10 kHz and are better than −80 dB in both left and right channels, only dropping to −75.7 dB at 20 kHz. The intermodulation distortion characteristics are also particularly good and better than we would have expected, considering the low level distortion measured at −60 dB and −80 dB.

Subjective testing

The subjective evaluation of the unit revealed a performance which is considerably better than I would have guessed considering either the price of the unit or the low level distortion figures at −80 dB. Undoubtedly, the most outstanding feature of this CD player is its ability to track and, more significantly, to play sample discs which are clearly labelled 'Not Playable'. The sample discs, given to us by Phonogram and Polygram, feature centre holes with an eccentricity of 1 mm which is beyond the tracking capabilities of other CD players. One of these discs in particular has been rejected by other machines which simply will not play it.

This feature has been carefully checked on every CD player we have reviewed, and also on a couple of others which were lent to us for evaluation. The NAD 5200 either immediately played these faulty discs or in some cases played them after three or more attempts. On the occasions when the NAD 5200 could not immediately play them it would churn around for a little longer than normal and latch into a tracking mode so that the disc could be played.

When Arthur Muldoon, the distributor's Sales Manager, had described the advanced tracking features of this particular machine I was sceptical. However, the evaluation procedures that I carried out fully confirmed his statements.

The next feaure that I liked in this machine is the ergonomic advantages that it achieves as a result of simplified controls. Most CD players give the impression that either the user requires a university degree or is a child younger than 12 years old (whom I have found capable of mastering new equipment faster than their parents). However, the NAD 5200 is just right for any age group to operate.

I evaluated the NAD 5200 in my bedroom and in my living room, and my younger son assisted with his own subjective evaluation in his room as well. While I was playing classical records and light pop music, my son's involvement was in the field of rock and pop and, in particular, the unplayable sample discs that we had never heard before (because the other players that we have reviewed would not track them).

Two of the faulty discs, 'Communique' by Dire Straits (Vertigo 800 052-2) and 'Oxygene' by Jean-Michel Jarre (Dreyfus FDM CD77000), not only proved the merits of the CD player but highlighted the extent to which this particular CD player can be used with modest amplifiers (twin 40 watt) and small high quality loudspeakers such as the B&W 110 or Technics SBX-100. With loudspeakers like these the unit still achieves what is unquestionably an exciting aural response in a small room.

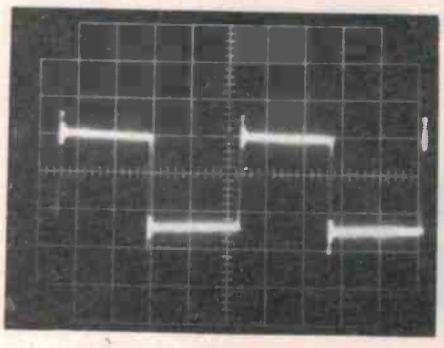
Conclusions

My overall impressions of this unit are that the majority of the manufacturer's claims have been fully substantiated. The most important claim of superior trackability is achieved to a degree that I would not have guessed possible.

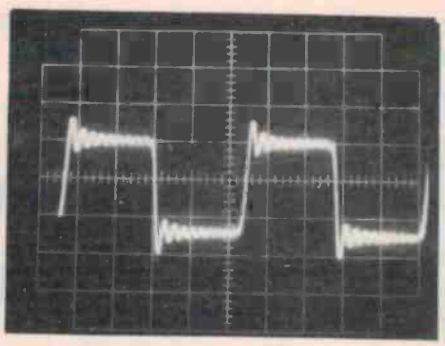
The only limitation that I could detect or measure in the performance of this unit was the low level distortion. However, during my subjective evaluation I could not readily detect the difference when carrying out comparisions with other machines whose linearity and distortion at these extremely low levels are amongst the best we have measured.

This machine is particularly well designed and with a recommended retail price of $969 this unit should be equally suitable in either a home or a broadcasting studio. ●

Measured square wave response using bands 37 and 38 on the Sony test disc, Type 3.



100 Hz



1 KHz

at the leading edge

VERTEX SLASHES LEAD TIMES ON 5¼" 70 MBYTE WINCHESTERS.

Consolidating their leadership in the delivery of predictably high quality, mass storage drives Vertex Peripherals are confidently ramping up their production to meet international market demands.

Australia continues to be treated favourably and high priority is given to requests for urgent deliveries.

Technically, Vertex is not standing still either. In addition to quoting better than 30 msecs average track access time they indicate that by the end of 1984 even higher performance will be easily achieved.

MINISCRIBE/WESTERN DIGITAL COMBO OFFERS 10 MBYTE WINCHESTER IN PERSONAL COMPUTING PRICE BRACKET.

By combining Miniscribe's 3012 half-height 5¼" Winchester and WDC'S WD1002-05 controller OEM'S can, with minimal host interfacing, produce a high performance mass storage unit.

Although Z80 type machines are the main targets units using other popular micros will also benefit.

3 INCH FLOPPY DRIVES BEING SHIPPED IN VOLUME.

Answering the call for more compact, power efficient and economical data storage Chinon have geared up to mass produce the industry standard 3" Floppy disk drive.

Designers familiar with the 5¼" Shugart interface, will be completely at home with the matching pinout of the CF301.

Power drain is minimised and uniform performance is assured by microprocessor control.

Pricing for the CF301 is expected to be very attractive to add-on builders tapping the lucrative, personal computer enhancement market.

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LISA & LOTUS LICK THE LOT IN LUNGE FOR LINE HONOURS

Your Computer magazine's awards for Personal Computer of the Year and Software Product of the Year gave industry pundits and punters a run for their money amid mild speculation and nervous expectation at the end of March.

Lisa laid a luminous lineup of US, Canadian and Japanese competitors for a clear win, ousting even the new generation of briefcase portables. It won because it met the award criteria of technical excellence in design, engineering and features, and contribution to the state of the art, along with ergonomic design in both hardware and software, user support and documentation, value for money and performance. The judges' decision was unanimous.

Lotus 1-2-3 stood alone as the one finalist in the inaugural Software Product of the Year Award.

In the words of Your Computer's consulting editor, Les Bell, "It is the ability to perform tasks originally thought impossible, and the fascination of continually discovering new and productive ways to do things, that are the marks of a truly excellent software package. That, quite simply, is why Lotus 1-2-3 is the Software Product of the Year."

Special commendations for Australian Hardware and Australian Software were given to the Microbee personal computer and the Zardax word processor respectively.

The Microbee has enjoyed tremendous success not only in Australia, but overseas as well. Over its very short lifetime, the 'Bee has been continually developed, all the while offering value for money and good performance. In recognition of the continued development of the 'Bee to its current sophisticated level, as well as for continuing to offer good value for money and unparalleled success in the domestic and export markets, the judges awarded Applied Technology the Australian hardware commendation.

Zardax is a wholly Australian developed and marketed word-processing package. It seems most people agree it is neither too difficult to use, nor too simplistic to be useful — a rare achievement. Zardax has been on-sale in the US for a while now, to enthusiastic acceptance from press and users alike. For this achievement, Qld-based Computer Solutions won the Australian software commendation.

The awards were presented by the Hon. George Paciullo, MP, NSW Minister for Small Business and Technology (at the time).

The computers that made the short-list, for the record, were: Apple Lisa (US), Bytec Hyperion (Canada), Canon AS-100 (Japan), Sharp PC-5000 (Japan), Texas Instruments Professional (US), plus the Tandy 100, NEC PC-8201A and Olivetti (M10) — all three being versions of the same machine, made by Kyocera in Japan. Only Lotus 1-2-3 made it to the software shortlist.

Software & microbee

MORE AVAILABLE ASK FOR FULL CATALOGUE

Educational

LEARNING CAN 'BEE' FUN

Now the full series by John Grimley in one value package containing 6 cassette tapes (or 1 diskette). Utilizing well known games such as 'Donkey Kong', 'Frog Hop', and 'Rescue' you can enjoy the game and learn at the same time.
Cassette Library Pack **$49.95**
Diskette Library Pack **$39.95**

MILLIKAN'S EXPERIMENT
Now you can deduce the charge of an electron. Graphic demonstration and tutorial for Year 11 and 12 physics students.
Cassette $14.95 ..... **Diskette $19.95**

WORD ADVENTURE
Follow the path and answer the synonym, antonym, homonym or correct the spelling, or the serpent will destroy you.
Cassette $14.95 ..... **Diskette $19.95**

GEOGRABEE

The whole family will enjoy trying to beat the clock whilst identifying oceans, countries and continents, on the excellently drawn maps. Ideal for school work.

Cassette $14.95 ..... **Diskette $19.95**

KEPLER'S LAW
A simulation of planetary orbits enabling students to analyse Periods, Elipses and Areas.
Cassette $14.95 ..... **Diskette $19.95**

WORK-A-BEE
This program actually helps you write your own educational software. Ideal for teachers.
Cassette $19.95 ..... **Diskette $19.95**

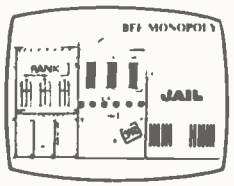
Games

VIPER
A highly addictive game. You must destroy the rabbits before they reach plague proportions but each time you catch a rabbit your tail grows.
Cassette $14.95 ..... **Diskette $19.95**

FROG HOP
A most graphic variation of the popular arcade game. You must hop across a busy street (watch out for the trucks . . .) and across a crocodile infested stream before your frogs are safely home. Guaranteed to appeal to all ages.
Cassette $14.95 ..... **Diskette $19.95**

SWORD QUEST
Just like the 'Dungeons and Dragons' series. Select your characters level of armour, weapons, strength and skill. Explore in search of treasure and the Great Sword, and battle with the dungeon's creatures.
Cassette $14.95 ..... **Diskette $19.95**

BEE MONOPOLY



Now a full graphic version of the old family game of the same name. The entire board, players, Community Chest and Chance cards are displayed as required in this fast moving game. Full details of land ownership and finances. Superb graphics and sound effects. (Requires 32K).
Cassette $14.95 ..... **Diskette $19.95**

DEFENDER
High speed, high resolution, high flying space arcade style game, guaranteed to keep you glued to your seat while you rescue the human race from alien invaders.
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CHESS

Try beating the computer at Chess. There are 6 levels of difficulty and a 'help' feature for the computer to make the next best move for you.

Cassette $14.95 ..... **Diskette $19.95**

MICROSPACE INVADERS '84
New update of one of the original microbee games. Now with full colour and joystick option. Sound and speed controls. Turn your microbee into a home arcade machine.
Cassette $14.95 ..... **Diskette $19.95**

ROBOTMAN '84
Now one of the most popular games ever written for the microbee, has been rewritten with new twists, a joystick and colour option.
Cassette $14.95 ..... **Diskette $19.95**

CANNIBALS AND MISSIONARIES
Take the cannibals and missionaries across the river but make sure there are not too many cannibals or . . . . GULP!
Cassette $14.95 ..... **Diskette $19.95**

EYE OF MIN 32K ONLY
The flash of light in the darkness is the Eye of Min Gem and you try to capture it — careful!
Cassette $14.95 ..... **Diskette $19.95**

YAHTZE
Add this well known dice game to your microbee. Two versions available on each cassette. A great family game!
Cassette $14.95 ..... **Diskette $19.95**

Utility

MICROBEE PASCAL In ROM
A good step into a new language. It incorporates an editor, a p-code single pass compiler and a p-code interpreter. **$59.50**

OZ-LOGO In ROM
A remarkable graphics language enabling your microbee to have outstanding graphics capabilities. **$49.50**

TUTORIAL:

Touch Typing Tutor and Basic Tricks. The microbee is an ideal educational computer recommended by educational authorities across Australia. This package enables you to learn to touch type using the Pitman touch typing method. For those who want to master Microworld Basic there is a series of hints and suggested subroutines arranged in a most effective menu driven style.
Cassette $14.95 ..... **Diskette $19.95**

PCG TUTORIAL
Opens up the 'mysteries' of microbee's programmable character generator to help you to design your own graphics.
Cassette $14.95 ..... **Diskette $19.95**

FORTH In ROM
Now microbee owners can use the powerful FORTH applications oriented program language. **$49.50**

SUPER DISASSEMBLER
This takes a machine code and translates it into Z80 standard mnemonics to utilise routines in other machine code programs.
Cassette $14.95 ..... **Diskette $19.95**

SKETCH PAD
Allows you to draw anything you might desire on the Bee. Circles, polygons and boxes etc. An excellent program.
Cassette $14.95 ..... **Diskette $19.95**

MORSE CODE TUTOR
Now you can learn the code that you thought was only the domain of the dedicated radio Ham. **Cassette $14.95** ..... **Diskette $19.95**

Business

GENERAL LEDGER
An excellent book-keeping program to keep your home or small business finances in order. Easy to use on 16 and 32K microbees.
Cassette $14.95 ..... **Diskette $19.95**

BUSY CALC
Fed up with constantly having to erase errors from your spread sheet? Busy Calc will help solve all your problems. Some commands are: Average, Sum, Compute, Format, Recalculate and Load and Save to cassette.
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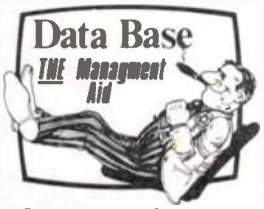
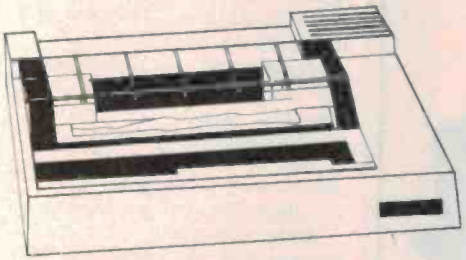
DATA BASE



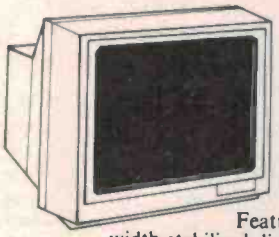
The ideal system for keeping lists of all those things you wish to recall during the year. Ideal for demonstrating Data Base concepts.

Cassette $14.95 ..... **Diskette $14.95**

Accessories



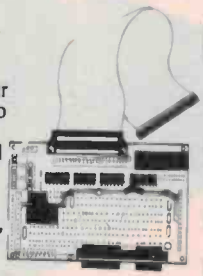
PRINTERS: microbee MB-80 DOT MATRIX printer. Fully supported by WORDBEE and WORDSTAR on the microbee systems. With full 80cps operation and normal 80 characters or 160 in condensed mode this is the ideal home office general purpose printer. Accepts both continuous and cut sheet stationery. Available in both serial RS232 and parallel versions. **Parallel $399.00 ..... Serial $449**
Spare Ribbons $9.75

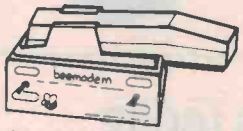


MONITORS: New release high quality monitors manufactured specially for the microbee by Mitsubishi. Features high band width stabilised display. Screen is anti-glare with ergonomically designed 10 degree tilt for optimum viewing. Available now in GREEN or AMBER phosphors.
Green $229.00 Amber $249.00

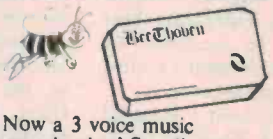
ROBOT ARM
A quality precision Robot Arm capable of being programmed to perform a wide range of ROBOTICS for practical and experimental purposes. **P.O.A.**

EXPERIMENTER BOARD: As reviewed in ETI January 1984, this board has been designed for those microbee owners who aren't afraid to wield a soldering iron. Includes full address and data buffers, decoding for 16 ports, Z80A PIO and on board regulators for +5V, +12V and -12V supplies. Generous general purpose PCB area **$69.50**





BEEMODEM: Telecom Approved to connect your microbee to other computers using the telephone lines. Your BEEMODEM will convert your microbee into a complete home terminal that can become your information window to the world!!! BEEMODEM operates at 300 BAUD CCITT standards. **$149.50**



BEETHOVEN: Now a 3 voice music synthesiser for your microbee! Supplied with support software including BEECOMPOSER which is effectively a full graphic MUSIC WORDPROCESSOR to create your own music as you go. **$99.00**

BEETALKER: Give your microbee a voice. Experiment with state of the art speech synthesis. This simple device plugs into the port on the microbee and, with powerful text to speech software supplied you will be amazed at how easy it is **$99.00**

HANDBOOKS AND MANUALS

Z80 Handbook ..... Nat Wadsworth	$9.95
Microsoft Basic Interpreter (CP/M-80) ..	$24.95
Inside CP/M A Guide for Users and .... Programmers — David E. Cortesi	$41.95
Microworld Z80 Editor/Assembler ..... Instruction Manual	$5.00
Microbee IC Integrated Computer	$5.00
Wordbee User's Manual	$5.00
Microworld 16K BASIC User's Manual .	$14.95
Introduction to Microbee ..... (1st 100 Programs) M. Duckworth & M. Davidson	$14.95
Microbee Disk System Manual	$19.95
Microsoft Multiplan Manual.....	$24.95

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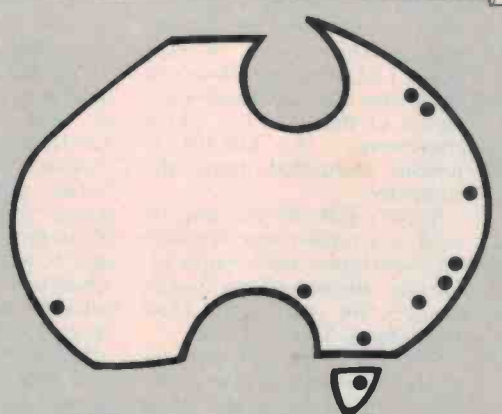

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microbee

EIGHT-PORT ETHERNET TRANSCEIVER

Time Office Computers has released a multiport transceiver, a compact, self-contained unit which allows up to eight devices to be attached to an Ethernet cable via a single tap which can normally support only a single device.

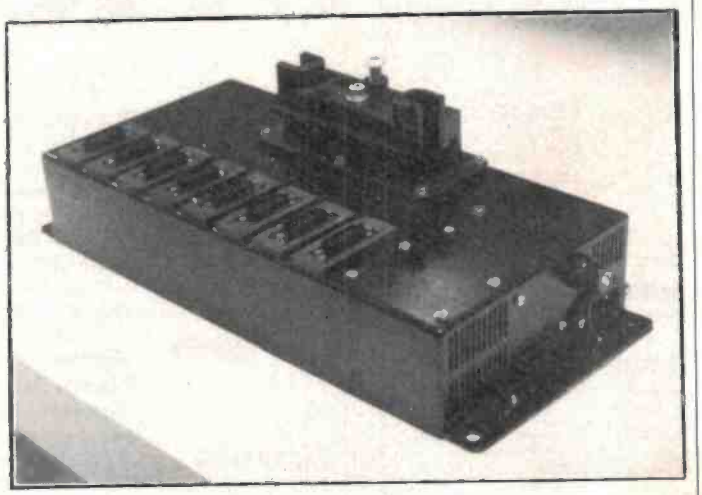
Devices are attached to the multiport transceiver by standard four-pair shielded cables which may be up to 50 metres long. The transceiver uses Emitter Couple Logic (ECL) to implement the Ethernet version 2.0 specification.

The transceiver has been developed in Australia by the Research Department of Time Office Comptuers and is manufactured by them in Artarmon NSW.

A multiport transceiver allows system network designers to connect a large number of devices to the Ethernet cable in a small area without having to coil up excessive lengths of cable, as is normally required to maintain the 2.5 metre separation between tapping points.

The multiport transceiver can be used without any coaxial cable as a small LAN of up to eight devices, using the CSMA/CD protocols.

For further information contact **Steve Luckett, Marketing Manager on (02)437-4355.**



XENIX FOR NS16032

In a joint statement, Microsoft Corporation and National Semiconductor Inc. announced that the Xenix Operating System will soon be available for National Semiconductor's new NS16032 microprocessor.

Xenix is Microsoft's licensed version of AT & T's Unix operating System specifically designed for the microcomputer market place to provide multi-user, multi-tasking capability.

"Xenix on the NS16032 is a super set of existing microprocessor versions of Xenix and will provide such features and virtual memory support. The large base of existing application software on Xenix will not be opened up to the NS16032," said John Ulett, Xenix Product Manager at Microsoft.

For further information contact **Microsoft Pty Ltd, P.O. Box 98, Terrey Hills NSW 2064 (02)450-2522.**

SANYO DATA/CASSETTE RECORDER

Sanyo say that they will help you save money with a compact cassette recorder that doubles for a computer data storage. The DR-101 cassette recorder is a computer data recorder and loader which is said to be compatible with all types of preprogrammed cassettes.

This convenient unit hooks up to a personal computer to record data onto a cassette, or load programs from a cassette. The unit's independent fast forward circuitry allows location of programs even when the computer stops the tape, and 'cue' and 'review' functions plus a tape counter simplify location of programs.

Signals can be monitored through the built-in speaker on the top of the DR 101 to allow audible verification of programs. A convenient control switch allows all types of preprogrammed tapes to be loaded into a computer. Setting volume is not required when loading the unit in 'Data' mode. A two-colour LED indicator allows you to monitor the 'Load' and 'Save' modes of the unit. For added convenience, the DR 101 is remote controlled from the computer.

Sanyo's DR 101 can also be used as a regular tape recorder for audio tapes, and a simple-to-operate 'Recorder/Data' switch changes the unit from Data Recorder to Tape Recorder.

Features of the tape recorder in audio mode include pause control for easier editing, and a built-in condensor microphone to allow recording at any time. Automatic Level Control assures accurate recording levels, and the Auto-Stop mechanism at the end of the tape in 'Play' and 'Record' modes reduces wear on tapes and mechanism.

The unit also has a convenient three-way power supply: dc 6 V (4 size 'C' batteries), ac 120/210/240 V or car battery (optional adaptor) 12 V.

The DR 101 from Sanyo comes complete with a C-12 blank tape and ac power cord, and is availble from electrical retailers, department stores, selected audio and computer specialists for around $89-$95.

For further information contact **Mr Wally Fabiszewski, Sanyo Australia Pty Ltd, 15 Mars Rd, Lane Cove NSW 2066. (02)428-0822.**

LOW COST PC PRINTER

Sigma Data Corporation has announced the release in Australia of the new Qume LetterPro 20 daisywheel printer.

Making the announcement, Mr Faktor, Sigma's Managing Director, stated, "This printer has been specifically designed by Qume to provide small businesses with affordable professional-quality word processing."

"Plug compatible with most popular desktop computers, the LetterPro 20 will enable personal computer owners to easily and inexpensively upgrade from dot-matrix to letter-quality printing," he said.

The LetterPro prints at a speed of 20 characters per second and Interface options comprise Centronics parallel, RS232 Serial, and Qume Sprint 3. Available accessories include a letter guide and a bidirectional forms tractor feed.

The same 96 character printwheels as used in Qume's broad range of Sprint series printers are also used with the LetterPro 20. More than 100 different typestyles are available, including many special character sets for professional and academic applications. Typestyles closely matching the most popular typewriter faces and true proportional spacing are also available.

Many of the design features found in the Qume Sprint II Plus family are also included in the LetterPro 20: the carriage design is the same; both use the easy-loading Qume Multistrike II and III ribbons; both support commanded bidirectional printing in 10, 12, 15 pitch and WPS.

In addition to the features mentioned above, the LetterPro has a tested reliability rating of 2000 hours without a single repair, the company claims.

Sigma Data Corporation is the authorised Australian distributor for Qume Corporation. The full range of Qume printer and terminal products are available through Sigma's Personal Computer Division and are fully supported by Sigma's technical team.

The quantity price is $896.

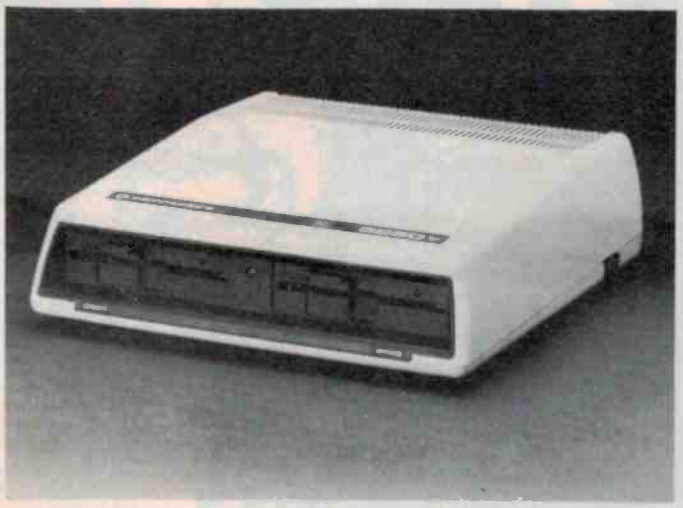
For further information, please contact **Dinah Lansley, Sigma Data Corporation, 157 Walker Street, North Sydney NSW 2060. (02)436-3777.**

COMMODORE'S DUAL DISK DRIVE UNIT

The Commodore 8250 LP (low profile) dual disk drive unit, now in Australia, contains its own microprocessor, 4K of buffer RAM and ROM-based disk operating system. This enables it to operate without using up RAM from the parent computer.

The model takes 5¼ inch disks, has double-sided drives and gives a total formatted capacity of 2.12 M. It supports relative record files and when copying data from one diskette to another does so without copying unused space. It is claimed to have improved error recovery and has the ability to append to sequential files.

For further information contact **Mr David Harvey, Commodore Business Machines, 5 Orion Rd, Lane Cove NSW 2066. (02)427-4888.**



LITTLE FUTURE FOR HOME MICRO SOFTWARE

There is little future for personal microcomputer software in the home, other than for games, according to a 272-page report from International Resource Development Inc, an independent market research firm in the US.

Non-game home software, which includes programs for income taxes, investments, budgeting and continuing education, is expected to make up only 1% or less of the annual micro software market over the next ten years. Games will constitute between 25% and 30% of the total.

According to IRD, the difference is that games have almost universal appeal while other personal software is sought after primarily by higher-income, better-educated buyers, a much smaller segment. And while games are purchased on a repeat basis, income tax or investment packages tend to be one-time expenditure.

However, IRD says that personal software will have an influence on the micro market that far exceeds its dollars value; it could be the clincher that persuades prospective purchasers to go with a home computer instead of a video game unit.

In the future there are likely to be overall declines in the unit shipment and dollar volume growth rates of the micro software, according to the report. These will be caused by the integration of existing package functions into more comprehensive programs (reducing unit shipments and average software expenditures per micro) and by user-friendly operating systems allowing users to perform a wide range of processing tasks for which they would previously have had to make additional software purchases.

IRD claims that the net result will be that the total package market will experience a slowdown of growth relative to the expansion of the micro hardware base. Even so, the market is expected to increase at a rate of about 25% annually.

The report predicts that the software developer's task over the next few years will become increasingly one of developing larger and more complex programs with more user-friendly operating modes. While there will clearly remain a place for the discrete specialized package, says IRD, the micro software industry is likely to follow developments in hardware — more powerful mechanisms in a smaller and cheaper 'box'.

ENHANCED MOUSE CAN DOODLE

The Microsoft Mouse, launched late last year for the IBM personal computer, has been upgraded to allow use with Lotus 1-2-3, Multiplan, Wordstar and Visicalc software. These applications join Microsoft's Word, word processing package which was the first Mouse-based application program to be released.

The Mouse is to remain at the same price of $295, with the enhanced capabilities and the addition of a picture creating program called Doodle.

The Microsoft Mouse is used to quickly move or reposition a cursor on the screen. When the user moves the Mouse across a flat surface, such as a desk, the cursor will track across the screen. No special prepared surface is required. Two buttons are provided to select decision alternatives or commands from the screen.

A disk is provided with the Mouse that contains three application programs designed to train the user in operating the Mouse.

For those users who already have a Microsoft Mouse an update policy is available from Microsoft to allow them to enjoy all the enhanced features for a charge of $10.00.

Those users wishing to update their Mouse can call Microsoft on **(02)450-2522** and ask Phil Jones for a return authorisation number. The user then only has to mail the disk to Microsoft for upgrading. Write to **Microsoft Pty Ltd, PO Box 98, Terry Hills NSW 2064.**

8086/8088 CROSS ASSEMBLER

The A8088 cross assembler runs on the DEC PDP-11 series of computers and produces object code suitable for the Intel 8086/8088 microcomputer.

The assembler will run on a range of DEC operating systems including RT-11, RSX-11M, RSTS/E and VAX/VMS. The assembler is written in PDP-11 assembler and can assemble code at the rate of 500 lines per minute.

Special directives are included to allow assembly with out generation of object code for mixed RAM/PROM systems. The fast turnaround of the edit, assemble and execute phases make this assembler a highly productive tool in the development of micro computer based equipment.

The object file produced is a hex ASCII file of 16 bytes records ready for transmission to a prom blaster or emulator system.

Further information can be obtained from **Mimaka Pty Ltd, 57 Tryon Rd, Lindfield NSW 2070. (02)467-2629.**

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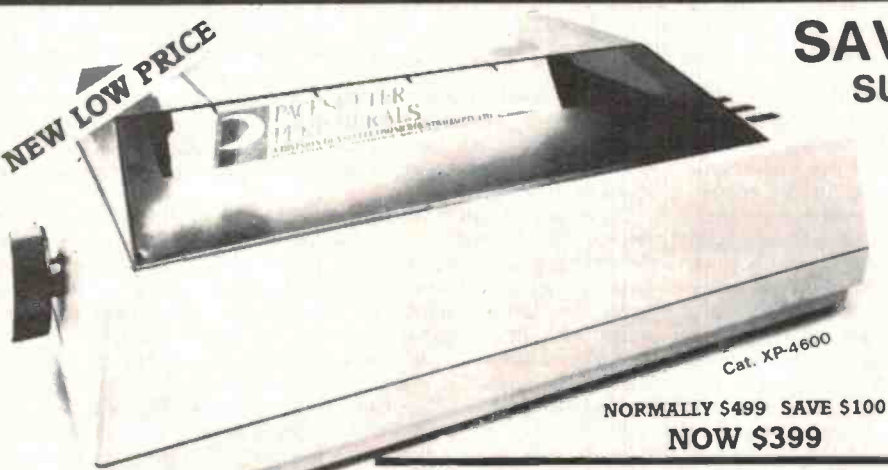

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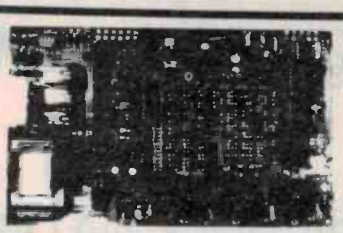
Arlec transformer as used in this project only $22.00



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Until now tilt bases were expensive or only fitted to expensive monitors. Now you can have one in your home for under $30!!!
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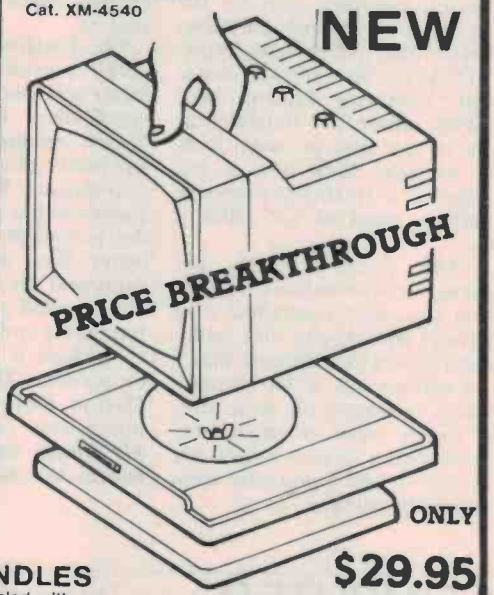

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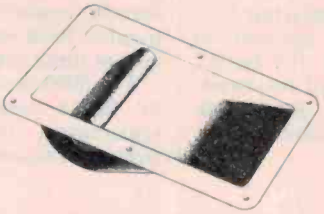

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This sequel to *The Cheap Video Cookbook* provides a complete video display system which you can build for as little as $7. Likewise, transparency display can be created for under $1 by using a video circuit called "The Snuffler" which is completely described in Chapter 2. This book makes cheap video even cheaper!
224 Pages. 5½ x 8½, soft.
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FAST, FRIENDLY DATABASE

Insystems is the Australian distributor of FastBase, a system which allows novice users of dBaseII database software to create their own screens quickly and easily. It is now available in this country.

As a user creates a screen, FastBase creates the equivalent dBaseII command files for file maintenance, record searching, screen input and printing forms.

Dr Simon Rosenbaum, Insystems' managing director, said, "While dBaseII is acclaimed as one of the most powerful tools of its type, until now it has required a relatively extensive training program for efficient use."

"The system, which has gained an international reputation as a super programmer for novices and experts alike, automatically creates dBaseII files."

FastBase has a file maintenance command file generator, a screen input command file generator, a form command file generator and a powerful command file utility.

The file maintenance command file generator also creates a search and command file routine that can easily be used in any other command file the user may write. The FastBase screen input command file generator allows the user to paint the data entry screen and automatically create a dBase II command file routine.

The FastBase command file utility provides tools to help create and modify dBaseII command files. These include: a 'squish' command file which will left justify all command lines on a command file, a 'structure' command file, which will indent the command lines of a command file, and a 'combine' command file, which will combine a called command file with the calling command file.

FastBase is manufactured by Fourcolour Data Systems of Dayton, Ohio, US. For further information contact **Insystems, 337 Moray Street, South Melbourne Vic. 3205. (03)690-2899.**

AUSTRALIAN MODEM WINS

Datacraft has just won contracts totalling $7.5 million with Telecom Aust. for its Australian designed and built high-speed data modem, the 5096.

The Melbourne based company won the contract against heavy competition from many of the world's leading modem suppliers.

Each year Datacraft is spending a greater proportion of its revenue on research and development, contrary to the current trend of local industry to spend less on these activities.

The 5096 modem is designed to be a single economical replacement for three data modems currently in wide use around the world, operating within specific performance ranges.

An important feature of the modem is that it automatically adjusts its electronic signals to suit different conditions in telephone circuits, making the product suitable for applications ranging from small in-house operations to data transfers across international circuits.

For more information contact **Datacraft (Australia) Pty Ltd, 168 Walker St, Nth Sydney NSW 2060. (02)929-7033.**

HYPERTYPER

Until an economic and fail-proof voice recognition device for the personal computer is invented, most of the data must be entered via the keyboard and that means typing.

To type well and fast puts you in front and Software City says that HyperTyper is just such a program to help you. It is available for most personal computers and terminals.

It helps to teach yourself to type or lets you improve your existing skills. The program encourages the development of good keyboard habits, including posture fingering and control.

The press release claims that HyperTyper is easy to learn. The program is under user control so you proceed at your own pace. The menus that guide you through the learning process are easy to understand and use. At the end of each lesson you get a report of the number of errors and accuracy, and the number of words per minute.

Literature on the HyperTyper is available from **Software City, 1/27 Forge St, Blacktown NSW 2148. (02)621-4242.** ●

COMPUTER CHIP WITH MORE POWER

Researchers in the Department of Electrical and Electronic Engineering at Queen's University, Belfast, believe they have solved the problems of packaging a microchip with more circuits and yet retain the speed of existing designs. They have designed a chip capable of packing in 25 per cent more circuits — working at least 10 times faster than present types.

One of the three-men team behind the new development is lecturer Dr Mervyn Armstrong. He said: "Although we have developed a new principle, quite a large amount of development work is still needed before a prototype chip could be successfully produced. It is, however, a major innovation for those creating and marketing tomorrow's chips."

The new approach is based on the ability to align exactly, certain essential layers used to make a chip. A chip in an average home computer has eight layers and contains the equivalent of 30,000 transistors, in contrast to an ordinary household radio which has about 30 transistors.

Until now the alignment of the layers could not be precisely controlled. This has meant the patterns on each essential layer have to be made a little larger so even if the overlying layers do not exactly register on top of the previous layer, some part of them would make contact.

The penalty is that this wastes valuable space. Exact alignment, which the researchers say they can now achieve, frees space for more circuitry.

The other problem was speed. An average home computer chip deals with two million pieces of information — called 'bits' — every second, which are processed through those 30,000 transistors.

But as more transistors are put onto the chip, the connections between them become smaller and thinner, slowing down the passage of current from one transistor to another, and consequently the response of the computer.

These connections are normally made from a material called poly silicon. To restore its efficiency when using thin connections the Belfast team have devised a technique to put (or register) a layer of aluminium on top of each part of the chip containing poly silicon. In terms of chip technology this is, say the researchers, a unique feat.

For the ordinary consumer, the Belfast development holds out the promise of medium priced computers which could support many more user terminals than at present.

It would also mean that fast acting industrial processes which can now only be monitored by giant computers could come within range of cheaper "micro" machines.

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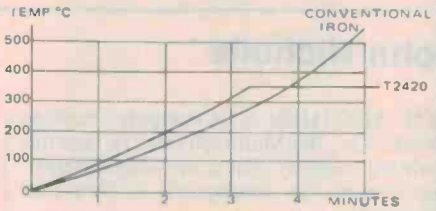

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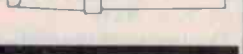

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The most essential piece of test gear (second only to a good multimeter) on any hobbyist's bench is some kind of audio signal generator. This design utilizes the latest circuit techniques to produce stable, low distortion waveforms.

A truly versatile unit at a bargain price.

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With the exception of the display all components mount on a single PCB making this kit suitable for all constructors.

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

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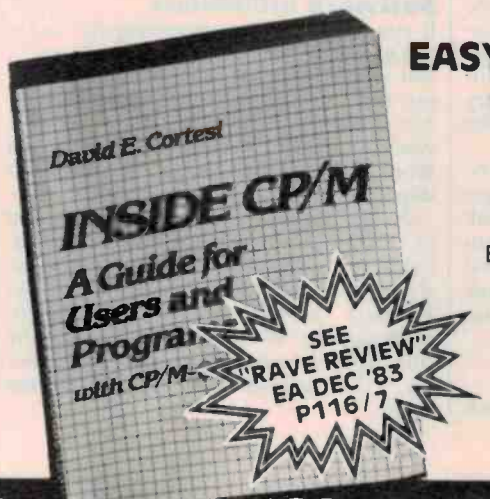

EASY READING GUIDE TO CP/M 2.2

As a learning tool — IT'S INVALUABLE
As a Reference — IT WILL TAKE PRIDE OF PLACE NEXT TO ANY CP/M SYSTEM

B9080.. ONLY **$41.95**

Devoted primarily to CP/M 2.2 this manual is equally applicable to most other CP/M systems. Cortesi divides the book in two sections, an **absorbing, explanative, tutorial** covering setup and operating procedures and a **comprehensive reference section.**

The Multitech MIC-504 reviewed

The market in CP/M-based machines is pretty crowded and getting more competitive week-by-week. A recent entry is the MIC-504 from the Taiwan-based Multitech Industrial Corporation. It comes with a suite of 'business' software and a very competitive price. Does it stand up?

John Nicholls

NOT ANOTHER 8-bit computer running CP/M? Yes, the Multitech does fit into this crowded category, but it has some interesting features to distinguish it from the competition.

Multitech is a new name to me and all I know about it is that the Multitech Industrial Corporation, to give its name in full, is situated in Taiwan. The company is represented in Australia by Emona Enterprises of Sydney, NSW.

The layout of the MIC-504 is conventional, consisting of a system unit with two 5¼ inch disk drives, a 12 inch monitor which normally sits on top of the system unit and a separate keyboard. The three components are all light grey with the monitor surrounds and disk drives picked out in black.

The units are quite compact, occupying noticeably less space than an IBM electric typewriter. Whereas most monitors are box-shaped, this one rolls off the top-back corners, an area which is just waste space in most monitors anyway. The advantage of this design is that it is very difficult to place anything on top of the monitor and thereby cause overheating.

Keyboard

The keyboard is simple in appearance. The normal typewriter keys are a lighter shade of grey than the 'shift', 'tab', return', seven function keys, cursor control keys and the dedicated editing keys. A full numeric keypad in conventional calculator layout occupies the right side of the keyboard. This numeric pad is well-designed for data entry with a large 'enter' key and a nipple on the '5' key to assist in touch typing.

Some aspects of the keyboard could be improved. The cursor keys are all in a single horizontal row, making it necessary to look at the keyboard to find them. The keyboard sits on four feet; our review model must have been warped because it rocked most disconcertingly whenever pressure was put on one corner.

Monitor

The design of the monitor is clean and uncluttered and the only controls are an on/off switch and a brightness control which are both on the front. The screen display is exceptionally good with the customary 24 lines of 80 characters. Each character uses a 7x11 dot matrix within a 9x12 field. Some sort of non-glare treatment appears to have been used as the screen is remarkably free from glare. The text looks different to that on the IBM monochrome display but is just as easy to read, which is the highest praise I can give it.

System unit

The system unit has the main on/off switch mounted on the back where it is not easy to use, especially as it is a rocker type which is difficult to locate by touch. The front of the unit has a large reset button and five status lights which I didn't find particularly useful. The disk drives are designed so that they are impossible to close unless a disk is in the drive.

Interaction between the processor and the display was more than satisfactory. Technical specs show that the Multitech MIC-504 uses a Z80A processor operating at 4 MHz with 64K RAM using eight 4164 memory chips. In practice, operation of the computer was quite fast, rather faster than you might expect from the 4 MHz clock.

Software inclusions

If you hope to sell a microcomputer today you must include a range of software with it, and this is what Multitech has done. You get the CP/M operating system (version 2.2), QSORT, NAD (Name and Address system), Magic Worksheet, Analyst and Word Right. (I understand that the latest shipments include CBASIC as well.)

All the application software is produced by Structured Systems Group of Oakland, California. As well as the operating manuals for the computer and the visual display, Multitech provide comprehensive documentation for all the software; in fact the volume of documentation is rather daunting. (The manuals make a stack 70 mm high!)

Manuals

The system and monitor manuals were apparently written in Taiwan and some of the language is a little unusual. I like the explanation of why it is called a "floppy disk", because "it gets hurt easily". The language doesn't present any real problem, but the user manuals are not very well set out. The steps for getting the computer operational and formatting the disks are not arranged in a clear, logical order (although all the information you need is in the manual) and the actual operation differs in many respects from what the manuals say.

For example, the manual says you should receive seven diskettes, whereas in fact you receive only three. These variations have no doubt occurred because the system has been changed but the documentation has not been changed along with it. The changes would be unlikely to cause any problems to an experienced user, but a novice at computing could easily become confused. For this reason, I would not recommend this system to a novice unless the support of a knowledgeable dealer is available.

The user manual has an appendix listing three 'System Boot Message Precautions'. The gist of the explanation is that you can ignore two of them and with the third you should enter CTRL-C. I think that the system should be designed to avoid such potentially confusing situations.

Software

Turning now to the software, the bulkiest manual is that for CP/M. This manual, courtesy of Digital Research Inc, has no index, is divided into sections without any way of indicating where each section starts, and is largely unintelligible. (A characteristic of Digital Research documentation — Ed.).

QSORT works on records of a maximum length of 255 characters on up to five sort keys. The output file can be on a different disk to the input file to allow larger files to be sorted.

NAD (Name and Address system) is designed for lists of names, addresses, telephone numbers and so on. Selections are made from a menu listing all the available operations. One interesting feature is that the program automatically saves to disk whenever the total number of records changed or added reaches ten. Although ten is the default, this can be changed.

Magic Worksheet is a spreadsheet program, and a fairly recent design, I would judge, by some of its features. It has an on-screen tutorial and full-screen HELP messages. After invoking HELP, a press of the 'escape' key returns you to where you were before. The maximum size of the worksheet is 64 columns by 255 rows. In practice, the size is limited by the amount of memory available

A menu of commands — spelt out in full — appears on the top line of the display and is selected by typing the initial letter of the command. Because there are more commands available than will fit on the line, an additional menu is invoked by the OTHER command.

We are now ready to start copying programs
Press RETURN when ready

DO NOT PRESS RETURN.
Instead, type: TILT and then press RETURN.

Confusion. This little gem is staight from the manual. Documentation though is quite good, despite some unusual language.

SPECIFICATIONS AND REPORT CARD

Unit	Multitech MIC-504
Made by	Multitech Industrial Corporation, Taipei, Taiwan
Processor	Z-80A
Clock speed	4 MHz
RAM	64 Kbytes
ROM	4K EPROM for boot strapping and firmware debugger
I/O	One RS232C serial port, one Centronics parallel port
Languages	CBASIC provided
Operating System	CP/M 2.2
Keyboard	QWERTY, numeric pad, 7 function keys
Display	80 by 24 green screen
Expansion	None mentioned in manuals
Best points	Software packages
Worst points	Taiwanese manuals

Ratings	**Excellent**	**Very good**	**Good**	**Poor**
Documentation		●		
Ease of use			●	
Functionality			●	
Support (?)	—	—	—	—
Value for money			●	

Extras included	CP/M, CBASIC, QSORT, NAD, Magic Worksheet, Analyst, Word Right, Spell Right
Price	$3799 including sales tax
Review unit from	Emona Computers, 661 George St, Sydney 2000. (02) 212-4815.

The range of mathematical operators in Magic Worksheet is somewhat similar to those in Visicalc, although the range of formatting options is more like those available in the more sophisticated Lotus 1-2-3. This appears to be one of the better spreadsheets around and anyone familiar with one of the popular varieties should have little trouble adapting to it.

Perhaps the best way to describe Analyst is to quote from the manual: "Analyst is a general purpose information storage and retrieval tool. It keeps customer and employee records, sales statistics, inventory lists, stock portfolios, schedules, name and address lists . . ." and a lot more, but you get the picture. As well as creating or modifying a data file, you can print a report or make an enquiry or extract information.

The word processing software, Word Write, also provides a tutorial and a context-sensitive help facility. The tutorial deals with the most-used commands first, then the less common ones. This means you can get started very quickly. The *CTRL* commands bear some resemblance to those used by WordStar, although there are differences. Word Write, however, makes no use of 'dot' commands. All the usual goodies are included; one that I particularly liked was that after an insert the text following is automatically adjusted.

The latest addition to Word Write is Spell Right. This uses a 20 000 word dictionary, which is on the small side in my opinion. It does, however, allow you to add words to the dictionary. Words not in the dictionary are displayed — not in context — and you have the usual choices: add to dictionary, mark for checking later in context, ignore or invoke the HELP facility. No suggestions for correction are given, so you need to refer to a print dictionary if you are unsure how to spell a word.

Amongst other statistics that Spell Right provides is the number of words read, a useful feature for writers who are paid by the word!

The documentation for the applications software is very good (the installation instruction added as an afterthought being an exception). Separate sections deal with installation, a background summary, the tutorial, the program commands and error messages. The error message section not only states what is wrong but how to fix it.

Summary

The Multitech MIC-504 appears to be a well-designed 8-bit computer that comes complete with a range of well-written, well-documented software. My only real points of criticism relate to the Taiwanese part of the documentation and to the keyboard.

The Multitech computer, with all the software mentioned and all cables — including a printer cable — has a retail price of $3799 *including* tax, which is remarkably competitive in the CP/M-based machines market area. The Australian distributors are Emona Computers of 661 George Street, Sydney, 2000. (02)212-4815. ●

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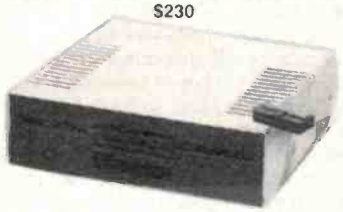

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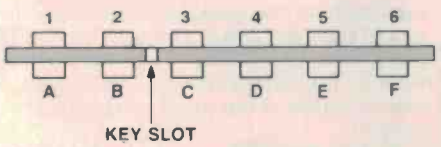
A VIC-20 audio cassette interface

Robert Irwin

This project, developed from an idea submitted by a reader, Paul Wadeson, allows the use of an ordinary, cheap, audio cassette player to load and save programs on the popular VIC-20 home computer.

THIS SIMPLE PROJECT allows all you impoverished VIC-20 owners, who are not in possession of the special VIC-20 Datacassette cassette player, to use your old, cheap, portable audio cassette player for storage and loading of files. Just about any audio cassette player can be used and the interface will supply all the necessary signals to the VIC-20 cassette interface port. Also, if you're lucky enough to have a cassette player with a remote control jack, then the interface will allow automatic stopping and starting of the cassette motor.



Pin	Type
A-1	ground
B-2	+5 V
C-3	cassette motor
D-4	cassette read
E-5	cassette write
F-6	cassette switch

VIC-20 CASSETTE CONNECTOR LOOKING INTO THE BACK OF THE VIC-20

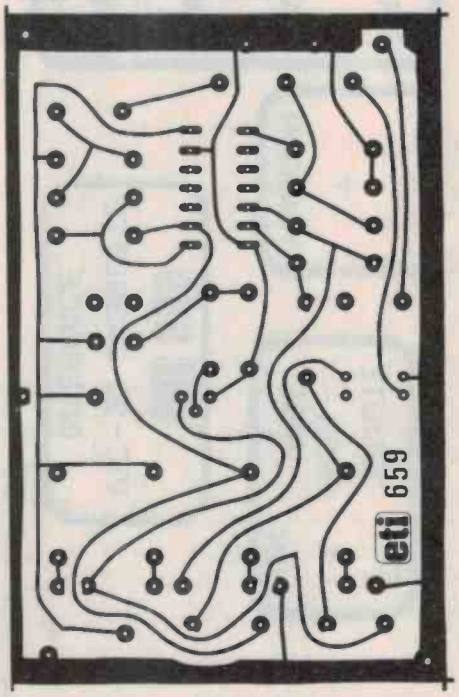
Design details

The cassette interface port on the VIC-20 is a 6-pin, double sided edge connector. Six signals are derived from this connector. These are +5 V, GROUND, CASSETTE MOTOR, CASSETTE READ, CASSETTE WRITE and CASSETTE SWITCH.

CASSETTE READ and CASSETTE WRITE are the data lines for loading and saving respectively. CASSETTE MOTOR is intended to turn the cassette on or off at the appropriate places during a save or load and CASSETTE SWITCH is an input signal which tells the computer when the play and record buttons are pressed on.

Most standard portable audio cassette players are set up with an earphone jack, a microphone jack and a remote jack. The interface uses the earphone jack for the READ data line and the microphone jack for the WRITE data line. The remote jack is controlled via a relay by the CASSETTE MOTOR signal and is used to turn the player on or off. The CASETTE SWITCH signal is required to be low to indicate that the play button on the cassette player has been pressed. This is achieved with a manual pushbutton mounted on the interface. The circuit is adapted from the popular ETI-660 Leaner's Microcomputer (1981) which proved to be reliable and relatively easy to use and is known to work with a wide variety of audio cassette players. ▶

Printed circuit. Full-size artwork.

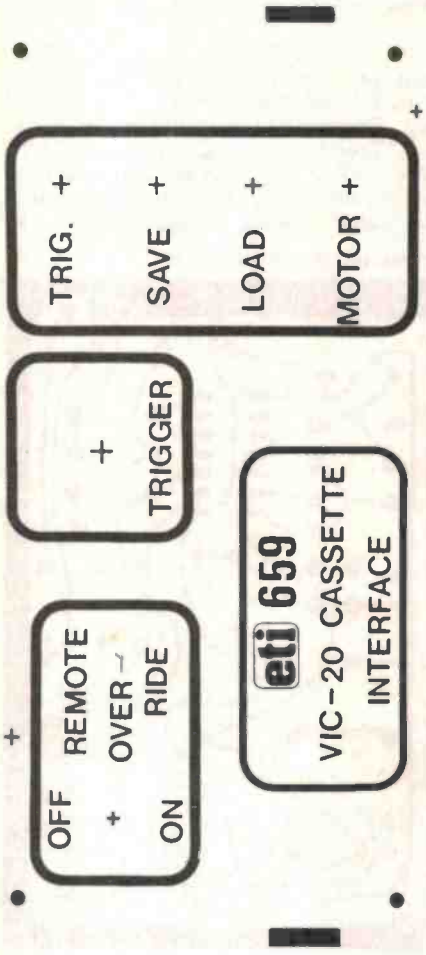


Construction

Construction is very simple as all of the components, with the exception of the manual override switch, are mounted on the pc board. Begin by carefully examining the pc board for any faults. Look for holes not drilled or incorrectly drilled and any small copper 'bridges' between closely-spaced tracks as well as for broken tracks. If everything is OK then solder the resistors and capacitors in place as per the overlay diagram. The relay and pushbutton can be mounted next followed by the transistor and IC. Finally, mount the four LEDs. These should be mounted so that the bottom of each LED stands about 7 mm from the face of the pc board. Do not cut off the excess lead on the LEDs yet in case the height needs to be adjusted later.

The prototype was housed in a medium (41x68x130 mm) zippy box. This was found to be an ideal size to house the interface. The aluminium lid should be removed and marked out for drilling using the front panel artwork as a template. Carefully line it up on the front panel and prick through the artwork at the hole centres using a scriber or compass point. Before drilling, just give a quick check to see that the pushbutton and LEDs line up with the marked centres. The hole for the pushbutton should be large enough to allow good clearance to enable the button to move in and out freely without snagging. A 7x12 mm indent should be cut in both ends of the front panel to allow for the entry of the cassette and VIC-20 connection cables.

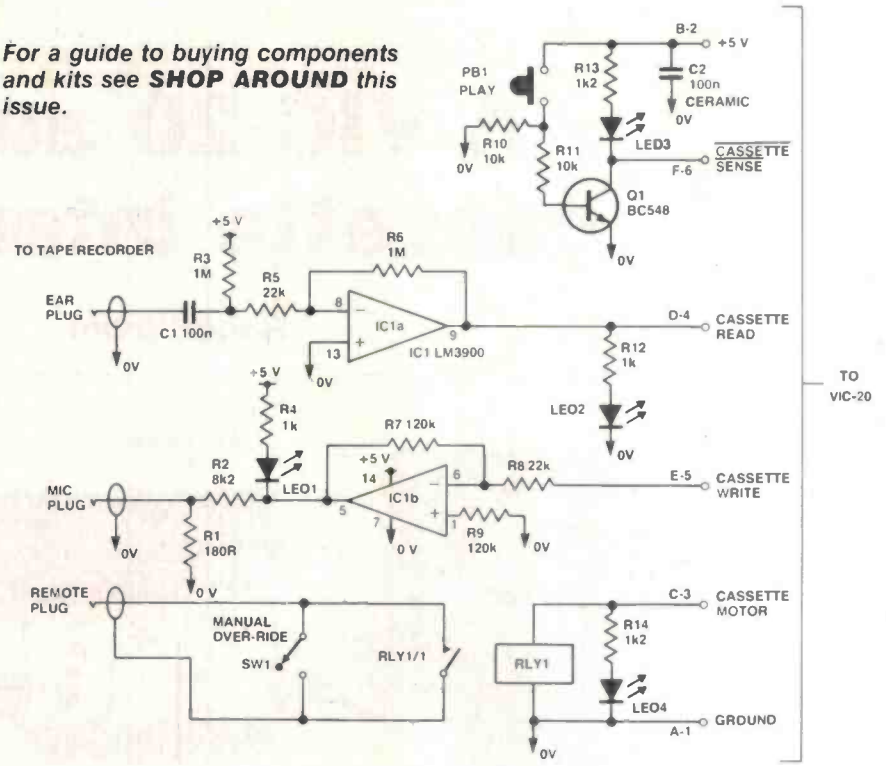
Front panel. Full-size artwork.



Once the front panel has been drilled a trial assembly should be done to ensure that the height of the LEDs is correct and that the pushbutton moves freely. It all is well then the Scotchcal front panel label can now be attached. Peel the backing off one edge and line this edge up with the appropriate edge of the lid. Carefully smooth the edge down until it has stuck and then pull off the remainder of the backing and smooth the rest of the label down. Once the label is in place, smooth out any remaining bubbles working from the centre out. The holes can now be trimmed out using a sharp knife or scalpel.

Before mounting the pc board to the front panel, attach suitable lengths of shielded cable and ribbon cable to the pc board as shown in the wiring diagram. The cassette lines should be terminated with appropriate plugs (usually 3.5 mm plugs for the earphone and mic sockets and a 2.5 mm plug for the remote socket).

*For a guide to buying components and kits see **SHOP AROUND** this issue.*



HOW IT WORKS — ETI-659

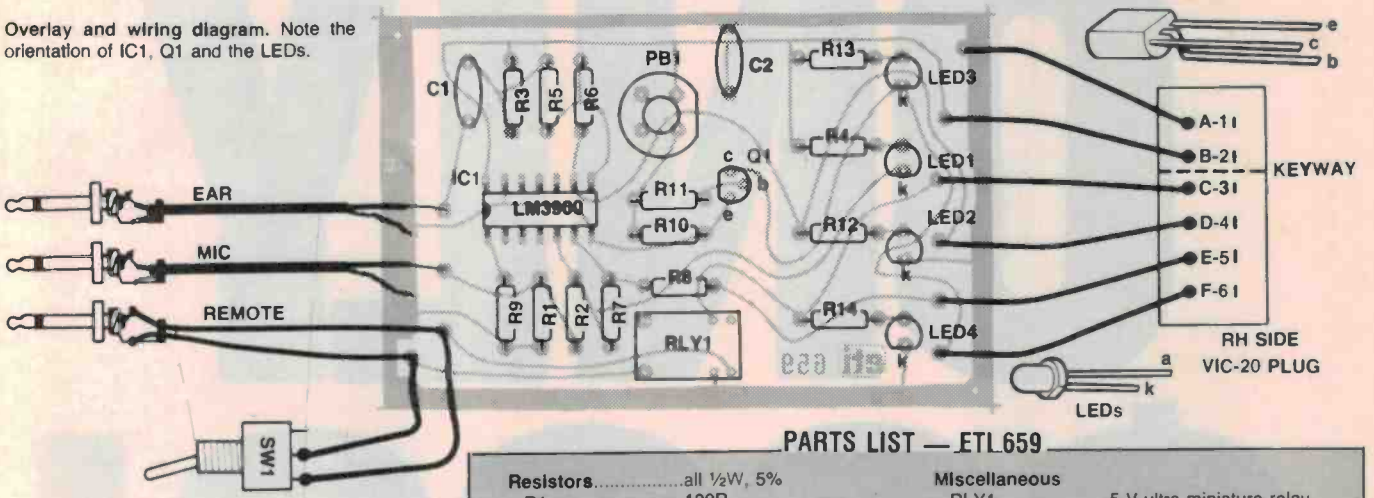
The interface is really four independent circuits on the one board. Let's start with the CASSETTE MOTOR circuitry.

Pin C-3 on the VIC-20 cassette interface port provides a 6 V signal when the motor is to be switched on. In the interface this signal is applied to the coil of a 5 V ultra-miniature relay. This then pulls in the normally open contacts which are connected to the remote jack of the tape recorder. This switches the recorder motor on. Switch SW1 is connected in parallel with the contacts and is used to manually switch the recorder motor on. Resistor R14 and LED4 provide visual indication that the contacts are closed.

The circuitry associated with Q1 provides the cassette SWITCH signal to the VIC-20. When pushbutton PB1 is pressed, base drive is applied to Q1 via R11. This turns the transistor full on and allows current to flow through R13 and LED1. The collector voltage of Q1 drops to a few millivolts. This signals the computer that the cassette is on. When the pushbutton is released the transistor is turned off and the collector voltage rises to about 5 V. Capacitor C2 is used to filter the 5 V supply from the VIC-20.

IC1 is an LM 3900 Quad Norton op-amp which can be run from the single +6 V supply. The LOAD circuitry uses on op-amp (IC1a) as an inverting amplifier stage. The gain of this stage is set to 45 by R6 and R5 and acts to 'square-up' the signal from the tape which is fed in via a coupling capacitor, C1. With a suitable level signal from the tape recorder, the output of the op-amp (pin 9) will drive from 0 V to +5 V and supply the signal to the CASSETTE READ input of the computer. This signal is also used to drive LED2 which acts as a visual indication that data is being loaded.

The CASSETTE WRITE pin from the computer drives another op-amp in the LM3900 package. This op-amp is configured as an inverting buffer with a gain of five set by R7 and R8. The output is then attenuated by a factor of 50, by R2 and R1, to a level suitable for recording. Varying R2 will vary the amplitude of the signal to the microphone input and can thus be changed to suit the recorder in use, although the given value should be suitable in most cases. LED1 works in a similar manner to LED2 and indicates that data is being transferred to the cassette.



Overlay and wiring diagram. Note the orientation of IC1, Q1 and the LEDs.

PARTS LIST — ETL659

Resistors ..... all ½W, 5%
- R1 ..... 180R
- R2 ..... 8k2
- R3, R6 ..... 1M
- R4, R12 ..... 1k
- R5, R8 ..... 22k
- R7, R9 ..... 120k
- R10, R11 ..... 10k
- R13, R14 ..... 1k2

Capacitors
- C1, C2 ..... 100n ceramic

Semiconductors
- IC1 ..... LM3900
- Q1 ..... BC548, BC108 etc.
- LED1, 2, 3, 4 ..... 5 mm red LED, TIL220R etc.

Miscellaneous
- RLY1 ..... 5 V ultra-miniature relay, pc board mount (e.g: Fujitsu FRL-211/D005-M).
- SW1 ..... SPDT miniature toggle switch.
- PB1 ..... Momentary action pushbutton, pc mounting (e.g: Altronics S1095/6/7/8/9).

ETI-659 pc board; two 3.5 mm audio jacks; one 2.5 mm audio jack; 6- or 10-pin 0.156" pitch edge connector; 200 mm of 6-way ribbon cable; one metre of shielded cable; two 12 mm spacers; jiffy box (130x68x40 mm); nuts, bolts and hookup wire; Scotchcal label.

Price estimate: $18-$20

To terminate the ribbon cable a 6-pin, 0.156" pitch edge connector is required. These seem fairly scarce, so on the prototype, I used a 10-pin connector and cut it down to size. It may be possible to get the "proper" connector from Commodore or a Commodore dealer (good luck!). Take care when wiring this plug to get the pin connections correct. The pinout for the VIC-20 cassette interface is given in the accompanying diagram.

The next step is to mount the remote override switch onto the front panel. This should then be connected to the PC board with about 50 mm of light gauge hookup wire. The pc board can now be mounted on to the back of the lid using 12 mm spacers. Make sure that the pushbutton moves freely and that the LEDs are the correct height to just poke through the holes by a couple of millimetres. If desired, LED mounting rings can be pushed into the holes first to hold the LEDs. Once the pc board is mounted the excess lead on the LEDs can be trimmed off. To complete construction, mount the lid assembly into the box ensuring that the connection cables fit neatly into the indents that you cut out of the lid.

Testing and using it

Before connecting the interface make sure that the VIC-20 is turned off. Plug the 6-pin edge connector into the cassette interface port making sure that it is the right way round, then turn on the VIC-20. A normal power-up message should be displayed. If a normal power up does not occur then switch the machine off immediately and check all wiring and connections on the interface. Once a normal power-up has been achieved there should be no LEDs lit on the interface unit. Check that when the pushbutton is pressed the TRIG and MOTOR LEDs are lit. If one or both LEDs stays off when the button is pressed then check the orientation of the LEDs and also of the transistor. You should also hear a click as the relay trips when the pushbutton is pressed.

If the switching is working correctly then connect up a tape recorder to the interface and insert a blank tape. If the remote plug is being used then, with the manual override in the off position, the cassette motor should be disabled. To check this press the PLAY button on the cassette. The motor should not turn on. If the trigger button is now pressed the motor should turn on until the pushbutton is released. To gain manual control for rewinding or cueing just turn the remote override switch to on.

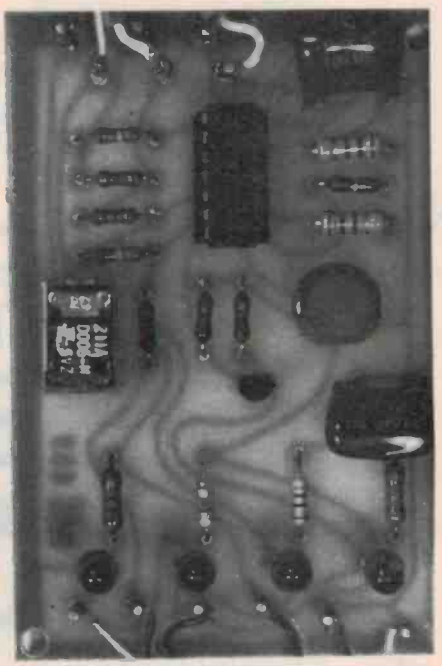
When loading or saving just type in the appropriate command. The VIC-20 should respond with a "PRESS PLAY ON TAPE" or "PRESS PLAY AND RECORD ON TAPE" prompt. You then just press the appropriate buttons on the cassette recorder and then the TRIGGER button on the interface. The cassette will then start and the MOTOR LED indicator should stay on.

During a SAVE or LOAD operation the appropriate LED on the interface will glow when information is being transferred. If these LEDs do not glow then this indicates that no information is getting through. This could be due to too low a volume setting on the cassette recorder.

As with most cassette storage systems it will be necessary to experiment with the playback volume in order to get reliable loading. Too high or too low a volume will result in a bad load and a LOAD ERROR message will appear on the screen. From experience I have found that if the playback volume is too high then, during a LOAD, the computer will frequently stop the tape and display the PRESS PLAY ON CASSETTE message. If the volume is too low then the computer will not read anything and will just keep searching through the tape.

If a CRO is handy, then the level can be set by examining the signal at the D-4 output of the interface during a load. Before the program information is accessed there will be a stable tone generated. The volume should be set so that this signal just begins to clip. If no CRO is available then just set the volume to about half way and do some trial and error adjusting from there.

Happy loading! ●



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Operating clock speed	2 MHz	1 MHz
RAM memory inbuilt	64K	64K
Maximum RAM possible	192K	128K
ROM memory inbuilt	32K	16K
Enhanced Microsoft BASIC?	YES	NO
Size of BASIC interpreter in ROM	24K	10K
Keyboard — number of keys	81	63
Numeric keypad	YES	NO
Function keys inbuilt	8	2
80-column text display inbuilt	YES	NO

FEATURE	CAT	Apple IIe
RGB colour output as standard	YES	NO
280x192 graphics: number of colours	8	6
560x192 graphics in colour	YES	NO
Sound channels	4	1
Disk drive capacity	140K	140K
Centronics type printer port inbuilt	YES	NO
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Ozi-Soft, in conjunction with Computer Technics, is offering to donate a VIC-20 expansion board for the best software item submitted to this column every month.

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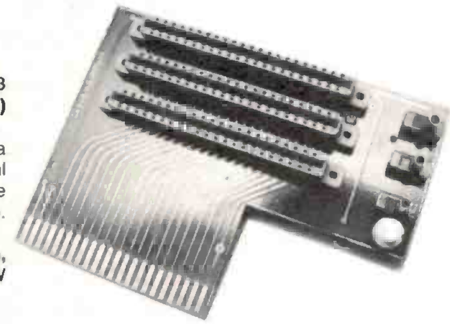
All submissions must be accompanied by a signed letter from you stating that it's your original work. The winning submission will be judged by the Editor and no correspondence will be entered into. All published submissions will be paid for.

Send entries to: **The Editor, VIC-20 Column, ETI Magazine, P.O. Box 227, Waterloo NSW 2017.**



CALENDAR

Ivan Curtis, Vale Park SA

The program prompts you for a month and a year and then produces a calendar of that month for that year.

The first day of the year (Monday — Sunday are represented by 0-6) is worked out by referring to a base year, 1980. This day is then adjusted to take leap years into account.

Using offset table in array OF%(), the first day of the required month is calculated. Note that this table is previously adjusted if the year in question is a leap year. Consecutive numbers are then 'poked' into the screen, starting with the calculated starting day until the end of the month.

Lines 3-7 are initialisation. Line 30 refers to the base year 1980 and line 40 calculates the starting day. Lines 50-70 adjust the number of days in the month and OF% according to leap years.

Lines 120-145 produce the screen display, 150-180 fill in the days, 200-250 are the subroutine to poke numbers into boxes on the screen, and 1000-1020 are the data.

```
3 PRINT"[CLR](22shift *)(6spc)CALENDAR(9spc)(22shift *)"
5 DIM M$(11),ND%(11),OF%(11)
7 FOR C=0 TO 11:READ M$(C):NEXT
10 INPUT" MONTH ";M$
20 INPUT" YEAR ";Y
30 N=Y-1980:L=INT((N+3)/4)
40 SD=1+N+L
50 LY=0:IF N/4=INT(N/4) THEN LY=1
60 OF%(0)=0:OF%(1)=3:FOR C=2 TO 11:READ A:OF%(C)=A+LY:NEXT
70 ND%(0)=30:ND%(1)=27+LY:FOR C=2 TO 11:READ A:ND%(C)=A:NEXT
80 P=12:FOR C=0 TO 11: IF LEFT$(M$,3)=LEFT$(M$(C),3) THEN P=C
90 NEXT
100 IF P=12 THEN INPUT" RE ENTER MONTH ";M$:GOTO 80
110 SD=SD+OF%(P):SD=SD-(INT(SD/7)*7)
120 PRINT"[CLR][R](22spc)":PRINT"[D][R] ";M$(P);Y
130 PRINT"[D][D][R](22shift+) MO TU WE TH FR SA SU ";
135 PRINT"┌──┬──┬──┬──┬──┬──┬──┐";
140 FOR N=0 TO 4:PRINT"I  I  I  I  I  I  I  I├──┼──┼──┼──┼──┼──┼──┤"
    ;:NEXT
145 PRINT"I  I  I  I  I  I  I  I└──┴──┴──┴──┴──┴──┴──┘"
150 D=1:FOR E=SD TO ND%(P)+SD
160 GOSUB 200
170 D=D+1
180 NEXT
190 PRINT" [D][D][R] PRESS "CHR$(34)"*"CHR$(34)" TO CONT."
195 GET A$:IF A$<>"*" THEN 195
197 RUN
200 D$=STR$(D):D$=RIGHT$(D$,2)
210 Y=INT(E/7):X=E-Y*7
215 AD=7680+22*(2*Y+4)+1+3*X
220 POKE AD,ASC(D$):POKE AD+1,ASC(RIGHT$(D$,1))
250 RETURN
```

+CONTINUED AT 1000+

```
1000 DATA JANUARY,FEBRUARY,MARCH,APRIL,MAY,JUNE,JULY,AUGUST
     ,SEPTEMBER,OCTOBER,NOVEMBER
1001 DATA DECEMBER
1005 DATA 3,6,1,4,6,2,5,0,3,5
1010 DATA 30,29,30,29,30,30,29,30,29,30
1020 END
```

VROGGER

David Abram, Banksia Park, SA

This is my version of the popular arcade game 'Frogger'. It wil run on an unexpanded VIC-20 and includes all the features of the 'real' game: logs, lorries, fast cars, etc. You've got to dodge these and get to the other side of the road and river. In the middle of the river you'll see a wide land mass which you can rest on. When you have successfully jumped all of your three frogs into their home bases, they all start again at the bottom of the screen.

If you get hit by a car, truck, log, etc, you lose a chance. Get hit three times and the game is over. Your score will then be displayed on the screen.

The game includes programmed characters, colour and sound effects. It should run on any VIC-20.

```
0 GOSUB10000
1 PRINT"[CLR]"
2 PRINT"[..]LLLKLLLLLLLKLLLLLLLKLLLL"
3 PRINT"[.......]IIIIIIIIIIIIIIIIIIIIII"
4 PRINT"[.......]IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII"
5 Y$="[.......................]":X$="[.......................]"
6 A=9:FY=18:FX=11:CO=38400:LI=3:POKE36878,15
10 A$=" @AB[...] @AB[...] @AB[...]"
20 B$=" @AB[...] @AB[...] @AB[...]"
30 C$="CD [.....]CD [..]CD [.]CD [..]"
40 D$="CD [..]CD [....]CD [.]CD [...]"
50 E$="EFFFFF [...]EFFFF [......]"
51 F$=" GH[.......] GH[......] GH[..]"
52 G$="[....]EFFFFF [....]EFFFFF "
100 PRINT LEFT$(Y$,3)"[.]"A$
101 PRINT LEFT$(Y$,5)"[.]"C$
110 PRINT LEFT$(Y$,7)"[.]"B$
111 PRINT LEFT$(Y$,13)"[.]"E$
112 PRINT LEFT$(Y$,15)"[.]"F$
113 PRINT LEFT$(Y$,17)"[.]"G$
114 PRINT LEFT$(Y$,9)"[.]"D$
115 B$=RIGHT$(B$,1)+LEFT$(B$,21)
116 D$=MID$(D$,2,21)+LEFT$(D$,1)
120 A$=RIGHT$(A$,1)+LEFT$(A$,21)
130 C$=MID$(C$,2,21)+LEFT$(C$,1)
140 E$=MID$(E$,2,21)+LEFT$(E$,1)
150 F$=RIGHT$(F$,1)+LEFT$(F$,21)
160 G$=MID$(G$,2,21)+LEFT$(G$,1)
180 P=PEEK(197)
190 IF P=31ANDFX>0THEN GOSUB 1000:FX=FX-1:GOSUB2000
200 IF P=23ANDFX<20THEN GOSUB 1000:FX=FX+1:GOSUB2000
210 IF P=17 THEN GOSUB 1000:FY=FY-2:GOSUB2000
220 IF P=33ANDFY<19THEN GOSUB 1000:FY=FY+2:GOSUB2000
221 POKE36875,200
225 IFPEEK(7680+FY*22+FX)=9ORPEEK(7680+FY*22+FX)=10THEN290
226 IFPEEK(7680+FY*22+FX)=11THENGOTO3000
230 IFPEEK(7680+FY*22+FX)<>32THENGOTO4000
290 REM
300 POKECO+FY*22+FX,6:POKE7680+FY*22+FX,10
310 POKE36875,0
320 SC=SC+.1
999 GOTO 100
1000 POKE36876,150:POKE 7680+FY*22+FX,A
1010 POKE36876,0:RETURN
2000 A=PEEK(7680+22*FY+FX)
```

TIME & STOPWATCH

Nigel Leed, Pyramid Hill, Vic.

☆★☆

This progam lets you input the correct time then prints it on-screen in 12 hour notation, 'ticking over' like a normal digital clock. Four alarms can be set, giving a 'bipping' sound when they go off. A stopwatch facility is also included, with display in hours, minutes, seconds and 1/10th second. Instructions are given on-screen.

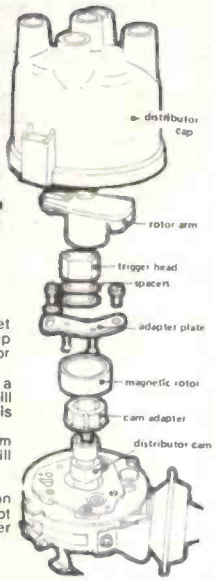
The stopwatch continues to run, oncě set going, even when you are watching the time display or setting the alarms. When you return to the stopwatch just press lap (F3) and the stopwatch continues.

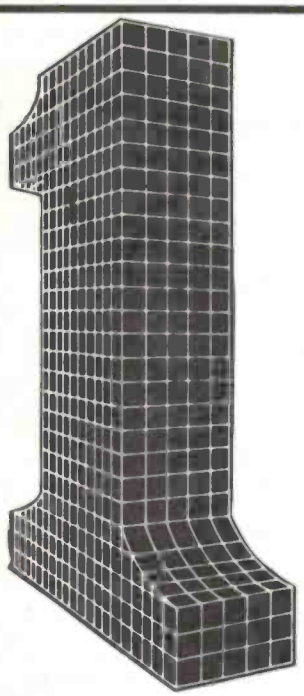
```
0 REM*******************WRITTEN BY  NIGEL LEED ON 19-7-83
5 DIMOF$(4),AL$(4),AM$(4) A$="120000"
10 PRINT"♥" FORA=1TO22 PRINT"◆"; NEXT PRINT
20 PRINT"<<< SELECTION FILE >>>" FORA=1TO22 PRINT"◆"; NEXT
30 PRINT"▼►►►■1■.  TIME"
35 PRINT"▼►►►■2■.  INPUT TIME"
40 PRINT"▼►►►■3■.  STOP WATCH"
50 PRINT"▼►►►■4■.  SET ALARMS"
70 PRINT"▼►►►■9■.  END"
75 PRINT FORA=1TO22 PRINT"◆"; NEXT PRINT"▼TYPE IN A NUMBER"
78 GETQ$ GOSUB900 Q=VAL(Q$) IFQ$=""THEN78
79 IFQ=9THENPRINT"♥" END
80 IFQ=1THEN100
81 IFQ=2THEN200
82 IFQ=3THEN300
86 IFQ=4THEN700
90 GOTO10
100 REM PRINTING TIME
110 PRINT"♥▼►►►►►■F7■ IT ┘T ~/"
140 A$=TI$
150 IFZ=9GOTO1000
152 PRINT"■▲▲▲▲▲▲▲▲▲▲▲►►►►■";
155 GETQ$ IFQ$=CHR$(136)THENPRINT"■" GOTO10
157 IFZ<>9THENGOSUB900
160 PRINTLEFT$(A$,2);"-";
170 PRINTMID$(A$,3,2);"-";
180 PRINTRIGHT$(A$,2);"  ";T$
183 T=VAL(TI$) T$="AM" IFT>115959THENT$="PM"
190 IFT>125959THENT=T-120000 A$=RIGHT$(STR$(T),6) GOTO150
195 IFT<10000THENT=T+120000 A$=RIGHT$(STR$(T),6) GOTO150
199 GOTO140
200 REM INPUT TIME **
210 PRINT"♥■" FORA=1TO22 PRINT"-"; NEXT
220 PRINT"►►K<< INPUT TIME >>>" FORA=1TO22 PRINT"-"; NEXT
230 PRINT"▼▼TYPE IN TIME TO SIX   DIDGITS THEN ■RETURN■
    TYPE IN AM OR PM THEN RETURN"
240 PRINT"▼►■EG■. 012354              ▼AM▼■■■FOR■ 1-23-54  AM"
248 PRINT"▼▼►►►►►■"A$
250 INPUT"■■■■■■■■■■■■■TIME",T1 INPUT"►►►AM■■■■";T$ IFT$="PM"
    ANDT1<120000THENT1=T 1+120000
252 IFT1>115959ANDT$="AM"THENT1=T1-120000 T1$=STR$(T1) T1$=
    "00000"+MID$(T1$,2,5) GOTO260
255 T1$=STR$(T1) IFLEN(T1$)=6THENT1$="0"+RIGHT$(T1$,5) GOTO260
256 IFLEN(T1$)=7ANDT$="AM"ANDT1<100000THENT1$="00"+RIGHT$(T1$,
    4) GOTO260
257 IFLEN(T1$)<>7THEN200
260 TI$=RIGHT$(T1$,6) GOTO10
300 REM  STOP WATCH
310 PRINT"♥" FORA=1TO22 PRINT"-"; NEXT
320 PRINT"►►K<< STOP WATCH >>>" FORA=1TO22 PRINT"-"; NEXT
330 PRINT"▼HIT ■F1■ TO START AND    STOP"
340 PRINT"▼HIT ■F3■ TO READ LAP"
350 PRINT"▼HIT ■F5■ TO RESET"
360 PRINT"▼HIT ■F7■ TO RETURN"
370 GETQ$ IFQ$=""THENGOSUB900 GOTO370
380 IFQ$=CHR$(133)THEN400
385 IFQ$=CHR$(134)THEN405
387 IFQ$=CHR$(135)THENB=0 PRINT"♥" GOTO300
390 IFQ$=CHR$(136)THEN10
395 GOTO370
400 TT=TI
405 T=TI I=T-TT
430 FS$=STR$(INT((I+B)/60*10)/10) PRINT
    "■▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲►►►►■";
432 S=INT((I+B)/60) M=INT((I+B)/3600) H=INT((I+B)/216000)
435 H$=STR$(H) M$=STR$(M-INT(M/60)*60) S$=STP$(S-INT(S/60)*60)
437 PT$=H$+"-"+M$+"-"+S$+"-."+RIGHT$(FS$,1)
438 PRINTPT$;"  ";
440 GETQ$ IFQ$=CHR$(136)THEN10
450 IFQ$=CHR$(133)THENB=B+I GOTO370
455 IFQ$=CHR$(134)THEN370
457 IFQ$=CHR$(135)THENB=0 PRINT"■▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲►►►►■
    " GOTO400
460 GOTO405
700 REM  SET ALARMS
710 PRINT"♥" FORA=1TO22 PRINT"-"; NEXT
720 PRINT"►►►K<< ALARMS >>>"
730 FORA=1TO22 PRINT"-"; NEXT
740 PRINT"▼■NO.   SET FOR"
745 FORA=1TO4 AL$=AL$(A) IFVAL(AL$(A))<10000ANDOF$(A)
    ="ON"THEN747
746 GOTO748
747 AB=VAL(AL$)+120000 AL$=STR$(AB)
748 AL$="000000"+AL$ AL$=RIGHT$(AL$,6)
750 PRINTTAB(1);A;TAB(6);LEFT$(AL$,2);"-";MID$(AL$,3,2);"-";
    RIGHT$(AL$,2);
760 PRINTTAB(15);AM$(A);
770 PRINTTAB(18);OF$(A)
780 NEXT
790 PRINT"▼TYPE IN WHICH ALARM   NO. YOU WISH TO CHANGETHEN
    PRESS RETURN OR  RETURN TO CONT."
800 INPUT"  0■■■";AL IFAL<0ORAL>4THEN800
805 IFAL=0THEN10
810 A$="000000"
820 PRINT"▼TYPE IN THE SIX DIGIT TIME" PRINT"  ";A$; INPUT
    "■■■■■■■■";AL$ IFLEN(AL$)<>6THEN820
821 IFVAL(AL$)>115959THENAB=VAL(AL$)-120000 AL$(AL)=STR$(AB)
    GOTO825
822 AL$(AL)=AL$
825 IFVAL(AL$(AL))>125959THEN820
830 PRINT"▼TYPE IN ■AM■ OR ■PM■" PRINT"  AM"; INPUT"■■■■",
    AM$(AL)
835 IFAM$(AL)<>"AM"ANDAM$(AL)<>"PM"THEN830
840 PRINT"▼TYPE IN ■ON■ OR ■OFF■" PRINT"  ON"; INPUT"■■■■";
    OF$(AL)
845 IFOF$(AL)<>"ON"ANDOF$(AL)<>"OFF"THEN840
850 GOTO700
900 FORA=1TO4 IFOF$(A)="OFF"ORAL$(A)=""THEN930
910 IFAM$(A)="PM"THENAB=120000
915 AL=VAL(AL$(A))+AB AL$="000000"+RIGHT$(STR$(AL),
    LEN(STR$(AL))-1)
920 IFTI$=RIGHT$(AL$,6)THENPRINT"♥"; GOTO1000
930 AB=0 NEXT RETURN
1000 Z=9 POKE36878,15 POKE36876,235 FORT=1TO90 NEXT POKE36878,
     0
1010 GETQ$ IFQ$=""THEN152
1020 Z=0 GOTO100
```

```
2010 RETURN
3000 POKE7680+FY*22+FX,14
3001 POKE36875,0
3005 FORX=1TO5
3010 FORT=250TO128STEP-5
3020 POKE36876,T NEXTT,X POKE36876,0
3030 H=H+1 IFH=3THENH=0 GOTO6000
3040 SC=SC+10 FY=18 A=9 FX=11 GOTO999
4000 POKE7680+FY*22+FX,13
4010 FORT=220TO127STEP-1 POKE36874,T POKE36875,T NEXT
4020 POKE36875,0 POKE36874,0
4030 LI=LI-1 IFLI<1THENGOTO5000
4040 FY=18 FX=11 A=9
4050 GOTO999
5000 POKE36869,240
5010 PRINT"♥GAME OVER"
5014 PRINT"▼YOUR SCORE WAS "INT(SC)
5015 FORT=1TO500 NEXT PRINT"▼▼▼HIT A KEY TO CONTINUE."
5020 IFPEEK(197)<>64THENPRINT"♥" POKE36869,255 RUN1
5030 GOTO5020
6000 FORT=128TO250STEP2 POKE36876,T POKE36876,0 NEXT
6010 FORT=250TO128STEP-2 POKE36876,T POKE36876,0 NEXT
6030 SC=SC+100
6040 PRINT"■■LLKLLLLLLKLLLLLLKLLLL"
6050 FY=18 FX=11 A=9 GOTO999
10000 POKE52,28 POKE56,28 POKE36869,255
10010 FORI=7168TO7280+7 READD POKEI,D NEXT
10020 DATA15,30,62,62,62,30,15,0
10030 DATA255,69,68,68,68,69,255,0
10040 DATA240,248,252,254,252,248,240,0
10050 DATA0,255,238,251,223,255,0,0
10060 DATA0,255,239,123,221,255,0,0
10070 DATA120,248,159,255,255,159,248,120
10080 DATA255,255,255,153,153,255,255,255
10090 DATA28,127,120,120,120,127,28,0
10100 DATA56,252,62,126,62,252,56,0
10110 DATA255,255,255,255,255,255,255,255
10120 DATA90,126,60,60,24,60,66,66
10130 DATA255,195,0,0,0,0,0,0
10140 DATA255,255,255,170,85,255,255,255
10150 DATA129,90,60,60,60,60,90,129
10160 DATA126,129,165,129,189,129,126,0
10500 FORI=7424TO7424+7 POKEI,0 NEXT
10510 RETURN

READY.
```

JAYCAR-YOUR No. SOURCE FOR ELECTRONICS





CONTACTLESS HALL-EFFECT "BREAKER POINTS"

A professionally engineered electronic ("breakerless") contact breaker system.
Yes, only Jaycar has a 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 & 6 CYLINDER CARS
- OVER 6 CAM-LOBE ADAPTORS
- OVER 12 DIFFERENT ADAPTOR PLATES FOR YOUR PARTICULAR DISTRIBUTOR
- OTHER HARDWARE (i.e. SCREWS etc)
- YOU CAN REMOVE THIS SYSTEM AND RE-EQUIP YOUR CAR WITH THE ORIGINAL BREAKER POINTS WHEN YOU SELL THE CAR!
- AS EASY TO INSTALL AS A SET OF POINTS
- INSTRUCTIONS (SIMPLE-TO-FOLLOW) INCLUDED

This set is designed to fit most European and Japanese cars. In fact it will also fit many Australian cars fitted with Lucas, Bosch, Motorcraft, AC Delco or Autolite electrics. If you wish to check first, please send SAE for car/distributor list.

SEE EA DECEMBER 1983

Because we have no way of knowing, you get the fitting set for ALL of the distributors available. Basically you end up with a jar full of parts you don't need to use! (Perhaps for your next car?)
Quite frankly, we are amazed that we can supply such a comprehensive kit for this price. To produce a kit that will adapt to the dozens of different distributors around is amazing!
Remember, once you have installed a breakerless system it will never wear out and that part of your system will remain in tune FOREVER.
Cat. KJ-6655
PLEASE NOTE: This system must be used in conjunction with an electronic ignition. The Hall-Effect device will not switch enough current to replace the contact breaker points on their own!

$29.95

TRANSISTOR ASSISTED IGNITION HALL-EFFECT "BREAKERLESS" VERSION $36.95

REF: EA DECEMBER 1983

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

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 version of this kit shown

BELOW MANUFACTURER'S COST!!

ONLY $125 COMPLETE
MASSIVE SAVING OF $74

AS REVIEWED
OCT '82
EA (p.26-28)
ETI NOV '82 (p.26)

CAT. XC2010

NEW IMPROVED MODEL!

Mail Order By BANKCARD Via Your Phone

FULL 90 DAY WARRANTY

At $199 the Voyager Car Computer represented absolutely outstanding value for money. No one else had such a low priced, **FULL FUNCTION** car computer. The Voyager is the only low-cost unit that will give you full consumption (the most important feature in a car computer) in both metric **litres/100km AND** good old **MILES PER GALLON!**

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 absolutely complete with all fitting hardware — even down to a roll of insulation tape! Installation generally takes between 4 and 6 hours depending on vehicle.

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

Jaycar Sydney (City)	**264 6688/267 1614**
Jaycar Concord	**745 3077**
Jaycar Carlingford	**872 4444**
Jaycar Hurstville	**570 7000**
Zap Electronics	**Parramatta**
	Hornsby

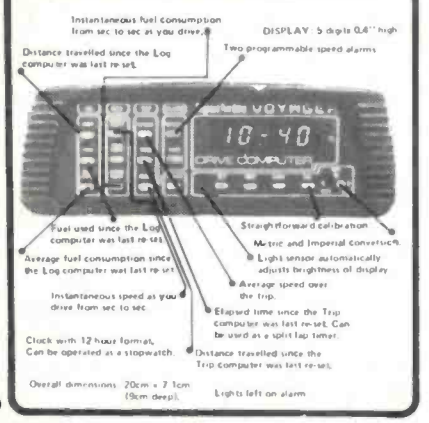
or by mail order to:

Rod Irving	
Melb A'Becket St	**(03) 347 9257**
Northcote	**(03) 489 8131**
Altronics Perth	**(09) 328 1599**
Jaycar	
Box 185	
Concord 2137	

Spare Flow Sensors: Jaycar will be supporting this product for many years to come. To avoid problems changing cars, why not buy a spare fuel flow sensor? They are about the only things that wear out!

Cat. XC2036
ONLY **$29.50**

VOYAGER OPERATING FEATURES



VCR SOUND PROCESSOR KIT

(Ref: EA April 1984)

Great new kit for Video Enthusiasts! ● Stereo Simulator ● 5 Band Graphic Equalisation ● Noise Filtering

The Jaycar kit once again is truly original - down to the genuine multicoloured knobs on the front panel (watch for substitutes). The only extra that you will need to buy is the optional whistle filter (Cat. EE-3814 $19.95)

Cat. KA-1545

$55 NEW!!

NEW!! NEW FREQUENCY COUNTER ADD-ON FOR YOUR EA FUNCTION GENERATOR

(Ref: EA April 1982) Nifty little add-on that allows you to use your function generator to digitally measure frequencies up to 150kHz. It also improves linearity of scale. (Designed to fit inside Function generator case)

Cat. KA-1547 **ONLY $12.00**

NEW!! - VIC 20 CASSETTE INTERFACE - (Ref: ETI May 1984)

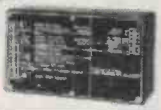
This nifty little project enables you to interface your "common garden" cassette player to load/store into a VIC 20 computer. It means that you don't have to buy an expensive purpose-built cassette player! (Includes 0.156" edge connector)

Cat. KE-4675 **$19.50**

NEW!! - DELUXE CAR BURGLAR ALARM

(Ref: EA May 1983) Great new design from EA. This one is very sophisticated. (Auxiliary battery extra) Complete kit of parts.

Cat. KA-1550 **$69.50**



NEW - MOTORCYCLE INTERCOM (Ref: EA March 1984)

Now you can talk freely and safely to your pillion passenger with this handy kit!

Cat. KA-1533 **$39.95**

NEW - IGNITION KILLER

(Ref: EA March 1984) Handy little project fits under your car to foil thieves. At this price can you afford not to have one?

Cat. KA-1535 **$14.95**

NOT NEW!! - EA DIGITAL CAPACITANCE METER

(Ref: EA September 1980) Ideal for a bench type mains powered application. Measures from 1pF to 99.99uF in only 3 ranges! Large easy to read LED display.

Cat. KA-1105 **$59.90**

VIDEO ENHANCER

A simple but effective kit to help improve copy recordings of video tapes. Kit complete

Cat. KA-1118 **$35.00**

(Ref: EA October 1983)

12/230V - 300W INVERTER

300VA of power at 235V from an ordinary 12V car battery. Superb Jaycar kit is complete

Cat. KA-1114 **$195.00**

(Ref: EA June 1982)

DUAL TRACKING #22V POWER SUPPLY

- Dual polarity can provide up to ±22V at up to 2 amps. Also has fixed output of +5V at 0.9A. Complete kit

Cat. KA-1410 **$89.50**

(Ref: EA March 1982)

MUSICOLOR IV

Sound to light effect with 4 channel chaser. There are 4 different chaser patterns plus a host of other features. Complete kit

Cat. KA-1010 **$89.90**

(Ref: EA August 1981)

ETI 1515 MOTOR SPEED CONTROL

Control the speed of your drill, saw, grinder, blenders etc. Effectively maintains speed over varying loads.

Cat. KE-4031 **$19.95**

THE RED FLASHER - (not illustrated)

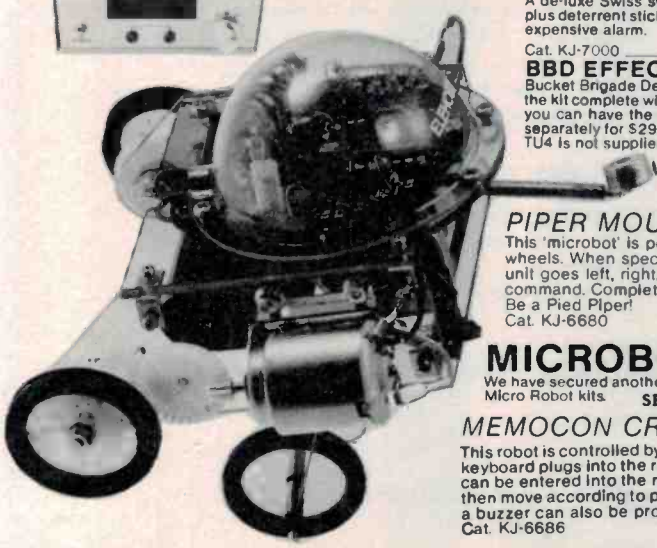
A de-luxe Swiss switch with electronics to make it flash plus deterrent stickers to make your car look as if it has an expensive alarm.

Cat. KJ-7000 **$20.95**

BBD EFFECTS BOX - (not illustrated)

Bucket Brigade Delay line using the MN3001 device. Buy the kit complete with TU4 box for $79 and for another $10 you can have the special Jaycar pre-punched box (sold separately for $29.50). If purchasing with special box the TU4 is not supplied.

Cat. KE-1522 **$79.00**



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 **ONLY $39.95**

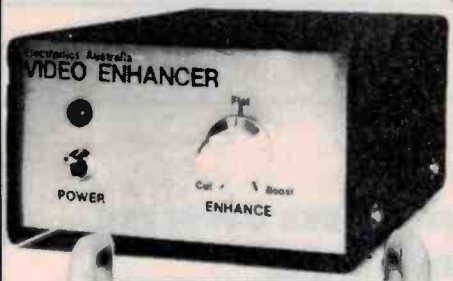
MICROBOTS® BACK!

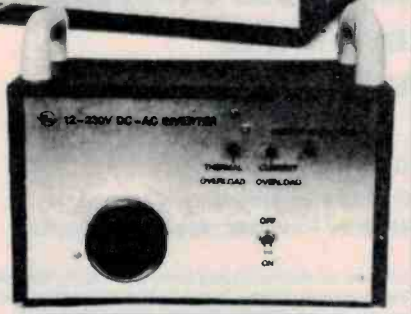
We have secured another shipment of the two most popular Micro Robot kits. **SEE REVIEW IN EA MARCH '84!**

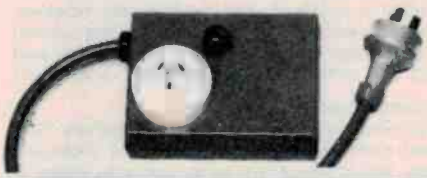
MEMOCON CRAWLER

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 **ONLY $79.95**







NEW!! LOW COST 3½ DIGIT LED PANEL METER KIT

build it yourself and save a fortune! ★ Massive 16mm high digits ★ Very few external components required ★ plus/minus 199.9mV full scale ★ Input impedance 10 to the twelve ohms! ★ Requires only 5-6V @ 150mA! ★ Guaranteed to reset to zero at zero input voltage ★ Auto reverse polarity indication ★ IC sockets included ★ Instruction sheet shows application ★ Notes to build Digital Thermometer, Capacitance meter, Frequency Counter etc.

STAGGGGGERING VALUE

$29.95 Cat. KJ-6670

COMPLETE WITH ATTRACTIVE BEZEL AND INBUILT FILTER!!

FUNCTION GENERATOR WITH DIGITAL READOUT

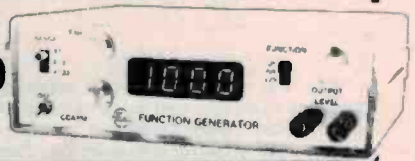
REF: EA APRIL 1982

This attractively housed (matches the KA-1390 DFM) unit produces sine, triangle and square waves over a frequency range from below 20Hz to over 160kHz with low distortion and good envelope stability. It has an inbuilt 4-digit frequency counter for ease and accuracy of the frequency setting.

The Jaycar kit is complete and even includes a free Tilting Bail worth $5.

Cat. KA-1428

$99



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MICROBEE CASSETTE INTERFACE MODIFICATION

Daniel Ford,
Engineering Manager,
Memory Products, Applied Technology

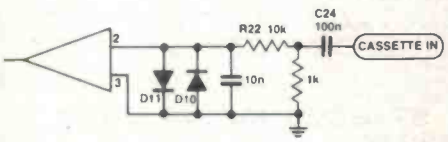
Anyone experiencing problems with saving and loading cassettes, particularly at 1200 baud, may like to try these suggestions:

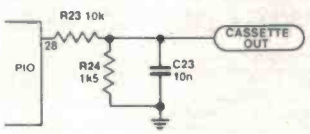
1. dc load
Some cassette machines require a dc (i.e: resistive) load on the earphone output. If yours if one of these, fit a 100 ohm resistor across the earphone connection, preferably inside the recorder.

2. Azimuth
Problems can occur if you try to load 1200 baud cassettes which were recorded on a different machine. If you know your recorder works reliably on 1200 baud, but it will not load someone else's 1200 baud tape, it may be that the azimuth of the two recorders is different.

Refer to Appendix B of the new Wordbee User Manual for details of azimuth adjustment. However, this is not recommended, as after adjusting azimuth to suit another recorder, you may not be able to load your own 1200 baud tapes without adjusting it back!

3. Circuit modification
The modifications shown provide improved 1200 baud performance on many cassette recorders. They should be carried out by someone skilled in electronics work, or by Applied Technology (a small charge will be made).





With this modification your optimum record/playback level will need to be re-established. For most low cost cassette machines, a setting between a third and a half of maximum has been found satisfactory.

The positions of R22 and C24 are reversed from the original. An extra 1k resistor has been fitted from the junction to ground and a 10n capacitor is connected across D10 and D11.

The values of R23, R24 and C23 are different from the original values. Put a link in the original C23 location. C23 is 10n and is fitted to test point TP8/9. The track from R24 to +5 V should be cut and grounded.

MORSE CODE TRAINING PROGRAM

A. J. Anderson, Stawell Victoria. VK3KAJ

This Morse Code training program was designed to be used by anyone who is learning Morse Code in order to obtain an amateur radio operator's licence.

MORSE CODE TRAINING PROGRAM

```
00150 CLS:PRINT:PRINT:PRINT"MORSE TRAINING PROGRAM introdution"
00160 DIM D(13)
00170 DATA 46,44,45,58,63,39,47,40,41,61,93,91,34
00180 FOR I= 1 TO 13:READ D(I)
00190 NEXT I
00200 PRINT:PRINT:INPUT"DO YOU REQUIRE INSTRUCTIONS  (Y or N) ";I0$
00210 IF I0$="Y" OR I0$="y" THEN GOTO 290
00220 CLS:PRINT:PRINT:PRINT"WHICH SECTION DO YOU REQUIRE"
00230 PRINT:PRINT"Section 1 :Learning"
00240 PRINT:PRINT"Section 2 :Single letters"
00250 PRINT:PRINT"Section 3 :Five letter groups"
00260 PRINT:INPUT"(1,2 or 3) ";S
00270 CLS:PRINT:PRINT:INPUT"Required tone (1 to 24) ";A
00280 ON S GOTO 440,510,1340
00290 CLS:PRINT:PRINT"The program has 3 sections. In section 1 the operator"
00300 PRINT"learns the basic morse sounds by pressing a key and"
00310 PRINT "hearing the morse code for that character."
00320 PRINT "In section 2 morse characters are sent to the operator"
00330 PRINT"which he/she must identify and type in the correct character."
00340 PRINT"In section 3 , groups of five morse characters are sent"
00350 PRINT"and must be read and typed back into the keyboard."
00360 PRINT"The letters and characters that are supported are:"
00370 PRINT"ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890,.:?'-/()="CHR$(34)"  the two ke
ys"
00380 PRINT"[ and ] correspond to the start and end of message"
00390 PRINT"characters respectivly. The speed is approx 5 w.p.m."
00400 PRINT"To change from one setion to another, Press the esc key."
00410 PRINT:PRINT"HIT ANY KEY TO CONTINUE"
00420 G0$=KEY$:IF G0$="" THEN GOTO 420
00430 GOTO 220
00440 CLS:PRINT:PRINT" MORSE TRAINING PROGRAM section 1 : Learning Characters":P
LAY 0,20
00450 CLS:PRINT:PRINT:PRINT:PRINT"PRESS KEY AND LISTEN FOR MORSE CHARACTER"
00460 A0$=KEY$:IF A0$="" THEN GOTO 460
00470 IF A0$=CHR$(27) THEN GOTO 220
00480 CLS:PRINT:PRINT:PRINT"THE CHARACTER ";A0$:PLAY 0,5
00490 GOSUB 690
00500 PLAY 0,5:CLS:GOTO 450
00510 CLS:PRINT:PRINT:PRINT "MORSE TRAINING PROGRAM section 2 : Single letters."
:PLAY 0,20
00520 CLS:PRINT:PRINT:PRINT
00530 GOSUB 550
00540 GOTO 650
00550 REM ********** CHARACTER SELECTION SUBROUTINE **********
00560 X=INT(RND*35)+65
00570 IF X>95 THEN GOTO 600
00580 IF X>90 THEN GOTO 620
00590 GOTO 630
00600 R=INT(RND*13)+1
00610 X=D(R):GOTO 630
00620 X=INT(RND*10)+48
00630 A0$=CHR$(X)
00640 RETURN
00650 PRINT"   MORSE CODE CHARACTER SOUND"
```

```
00660 PLAY 0,5:C=1
00670 GOSUB 690
00680 GOTO 1210
00690 REM ********** CHARACTER TABLE SUBROUTINE **********
00700 IF A0$=CHR$(27) THEN RETURN
00710 IF A0$="A"OR A0$="a": PLAY A,1;0,1;A,3;0,3
00720 IF A0$="B"OR A0$="b": PLAY A,3;0,1;A,1;0,1;A,1;0,1;A,1;0,3
00730 IF A0$="C"OR A0$="c": PLAY A,3;0,1;A,1;0,1;A,3;0,1;A,1;0,3
00740 IF A0$="D"OR A0$="d": PLAY A,3;0,1;A,1;0,1;A,1;0,3
00750 IF A0$="E"OR A0$="e": PLAY A,1;0,3
00760 IF A0$="F"OR A0$="f": PLAY A,1;0,1;A,1;0,1;A,3;0,1;A,1;0,3
00770 IF A0$="G"OR A0$="g": PLAY A,3;0,1;A,3;0,1;A,1;0,3
00780 IF A0$="H"OR A0$="h": PLAY A,1;0,1;A,1;0,1;A,1;0,1;A,1;0,3
00790 IF A0$="I"OR A0$="i": PLAY A,1;0,1;A,1;0,3
00800 IF A0$="J"OR A0$="j": PLAY A,1;0,1;A,3;0,1;A,3;0,1;A,3;0,3
00810 IF A0$="K"OR A0$="k": PLAY A,3;0,1;A,1;0,1;A,3;0,3
00820 IF A0$="L"OR A0$="l": PLAY A,1;0,1;A,3;0,1;A,1;0,1;A,1;0,3
00830 IF A0$="M"OR A0$="m": PLAY A,3;0,1;A,3;0,3
00840 IF A0$="N"OR A0$="n": PLAY A,3;0,1;A,1;0,3
00850 IF A0$="O"OR A0$="o": PLAY A,3;0,1;A,3;0,1;A,3;0,3
00860 IF A0$="P"OR A0$="p": PLAY A,1;0,1;A,3;0,1;A,3;0,1;A,1;0,3
00870 IF A0$="Q"OR A0$="q": PLAY A,3;0,1;A,3;0,1;A,1;0,1;A,3;0,3
00880 IF A0$="R"OR A0$="r": PLAY A,1;0,1;A,3;0,1;A,1;0,3
00890 IF A0$="S"OR A0$="s": PLAY A,1;0,1;A,1;0,1;A,1;0,3
00900 IF A0$="T"OR A0$="t": PLAY A,3;0,3
00910 IF A0$="U"OR A0$="u": PLAY A,1;0,1;A,1;0,1;A,3;0,3
00920 IF A0$="V"OR A0$="v": PLAY A,1;0,1;A,1;0,1;A,1;0,1;A,3;0,3
00930 IF A0$="W"OR A0$="w": PLAY A,1;0,1;A,3;0,1;A,3;0,3
00940 IF A0$="X"OR A0$="x": PLAY A,3;0,1;A,1;0,1;A,1;0,1;A,3;0,3
00950 IF A0$="Y"OR A0$="y": PLAY A,3;0,1;A,1;0,1;A,3;0,1;A,3;0,3
00960 IF A0$="Z"OR A0$="z": PLAY A,3;0,1;A,3;0,1;A,1;0,1;A,1;0,3
00970 IF A0$="1": PLAY A,1;0,1;A,3;0,1;A,3;0,1;A,3;0,1;A,3;0,3
00980 IF A0$="2": PLAY A,1;0,1;A,1;0,1;A,3;0,1;A,3;0,1;A,3;0,3
00990 IF A0$="3": PLAY A,1;0,1;A,1;0,1;A,1;0,1;A,3;0,1;A,3;0,3
01000 IF A0$="4": PLAY A,1;0,1;A,1;0,1;A,1;0,1;A,1;0,1;A,3;0,3
01010 IF A0$="5": PLAY A,1;0,1;A,1;0,1;A,1;0,1;A,1;0,1;A,1;0,3
01020 IF A0$="6": PLAY A,3;0,1;A,1;0,1;A,1;0,1;A,1;0,1;A,1;0,3
01030 IF A0$="7": PLAY A,3;0,1;A,3;0,1;A,1;0,1;A,1;0,1;A,1;0,3
01040 IF A0$="8": PLAY A,3;0,1;A,3;0,1;A,3;0,1;A,1;0,1;A,1;0,3
01050 IF A0$="9": PLAY A,3;0,1;A,3;0,1;A,3;0,1;A,3;0,1;A,1;0,3
01060 IF A0$="0": PLAY A,3;0,1;A,3;0,1;A,3;0,1;A,3;0,1;A,3;0,3
01070 IF A0$="[": PLAY A,3;0,1;A,1;0,1;A,3;0,1;A,3;0,1;A,3;0,3
01080 IF A0$="]": PLAY A,1;0,1;A,3;0,1;A,1;0,1;A,3;0,1;A,1;0,3
01090 IF A0$=",": PLAY A,3;0,1;A,3;0,1;A,1;0,1;A,1;0,1;A,3;0,1;A,3;0,3
01100 IF A0$=".": PLAY A,1;0,1;A,3;0,1;A,1;0,1;A,3;0,1;A,1;0,1;A,3;0,3
01110 IF A0$=":": PLAY A,3;0,1;A,3;0,1;A,3;0,1;A,1;0,1;A,1;0,1;A,1;0,3
01120 IF A0$="?": PLAY A,1;0,1;A,1;0,1;A,3;0,1;A,3;0,1;A,1;0,1;A,1;0,3
01130 IF A0$="?": PLAY A,1;0,1;A,3;0,1;A,3;0,1;A,3;0,1;A,3;0,1;A,1;0,3
01140 IF A0$="-": PLAY A,3;0,1;A,1;0,1;A,1;0,1;A,1;0,1;A,1;0,1;A,3;0,3
01150 IF A0$="/": PLAY A,3;0,1;A,1;0,1;A,1;0,1;A,3;0,1;A,1;0,3
01160 IF A0$="(": PLAY A,3;0,1;A,1;0,1;A,3;0,1;A,3;0,1;A,1;0,3
01170 IF A0$=")": PLAY A,3;0,1;A,1;0,1;A,3;0,1;A,3;0,1;A,1;0,1;A,3;0,3
01180 IF A0$="=": PLAY A,3;0,1;A,1;0,1;A,1;0,1;A,1;0,1;A,3;0,3
01190 IF A0$=CHR$(34):PLAY A,1;0,1;A,3;0,1;A,1;0,1;A,1;0,1;A,3;0,1;A,1;0,3
01200 RETURN
01210 IF C=3 THEN GOTO 1330
01220 CLS:PRINT:PRINT:PRINT
01230 PRINT" CHARACTER   ????   ";
01240 B1$=KEY$:IF B1$="" THEN GOTO 1240
01250 IF B1$=CHR$(27) THEN GOTO 220
```

continued . . .

MACHINE CODE MONITOR MODIFICATIONS

H. N. Broadbent, Balwyn Vic.

The Machine Code Monitor program which was published on page 61 of ETI, January 1984, has a bug in it; the data listing ends each line with a comma.

The cure is simple and is shown in this modified program. Lines 370 and 390 have had CHR(8); CHR(127) added. This backspaces and deletes the offending comma.

MACHINE CODE MONITOR MODIFICATIONS

```
00100 DIM Z(5) :I=0    :CLS
00110 PRINT "PRESS [BACK SPACE] TO
      EDIT , [ESC] TO FINISH"
00115 REM CONVERT HEX ADDRESS TO
      DECIMAL
00120 PRINT//"STARTING ADDRESS
      (IN HEX)"
00130 K=ASC(KEY):IF (K<48 OR K>57)
      AND (K<65 OR K>70) THEN 130
00140 PRINT    CHR(K); :IF K<58 THEN
      LET K=K-48 ELSE LET K=K-55
00150 Z(I)=K: I=I+1 :IF I<4 THEN
      130
00160 S=Z(0)*4096+Z(1)*256+Z(2)
      *16+Z(3): T=S :CLS
00170 UNDERLINE :PRINT"00  01  02
      03  04  05  06  07";
00180 PRINT"  08  09  0A  0B  0C
      0D  0E  0F":NORMAL
00190 A=ASC(KEY)
00195 REM CHECK FOR ESCAPE OR
      BACKSPACE
00200 IF A=27 THEN 310
00210 IF A=8 THEN PRINT [A4 8];
      :S=S-1 :GOTO 190
00215 REM ONLY LET 48-57 OR 65-70
      ASCII CODES THROUGH
00220 IF (A<48 OR A>57) AND (A<65
      OR A>70) THEN 190
00230 PRINT CHR(A);
00240 B=ASC(KEY)
00250 IF (B<48 OR B>57) AND (B<65
      OR B>70) THEN 240
00260 PRINT CHR(B);"  ";
00265 REM CONVERT ASCII CODE TO
      DECIMAL NUMBER (0 TO 16)
00270 IF A<58 THEN LET A=A-48 ELSE
      LET A=A-55
00280 IF B<58 THEN LET B=B-48 ELSE
      LET B=B-55
00290 N= A*16+B: POKE S,N: S=S+1
00300 GOTO 190
00305 REM CREATE DATA STATEMENTS ON
      TAPE
00310 PRINT " Set up tape recorder,
      press a key when ready"
00320 KO$=KEY : IF KO$="" THEN 320
00330 C=0: L=10000: OUT#2 ON: PRINT
      L;" DATA";
00340 FOR J=T TO S-1
00350 PRINT PEEK (J);" , "; :C=C+1
00360 IF C<16 OR  J=S-1 THEN 380
00370 L=L+10: PRINT CHR(8);
      CHR(127); CHR(13);CHR(10);
      L;" DATA "; :C=0
00380 NEXT J
00390 PRINT CHR(8);CHR(127);CHR(26)
      :OUT #2 OFF
00400 END
```

MICROBEE COLUMN

EASTER SUNDAY DATES

Noel Bailey, Maryland NSW

This program will calculate the date that Easter Sunday falls on for any year of the Gregorian calendar. The algorithm is from an article by T. H. O'Beirne which was published in 'New Scientist' on the 30th March, 1961.

In AD 325 the council of Nicasea ordered that Easter was to be the Sunday which followed the full moon which occurred on, or next after, the day of the spring equinox.

Arithmetical procedures have been developed over the centuries. The algorithm is listed in ten steps below. This is an excellent algorithm to cut one's teeth on when trying out new computer languages.

EASTER SUNDAY DATES

```
00170 LPRINT
00180 INPUT'FIRST YEAR = ';Y
00190 INPUT'LAST YEAR = ';Z
00200 LPRINT 'EASTER SUNDAY'
00210 LPRINT '--------------'
00220 FOR X=Y TO Z
00230 GOSUB 300
00240 IF P<10 THEN LPRINT' ';
00250 LPRINT P;TAB(10);
00260 IF N=3 THEN LPRINT'MARCH';ELSE
      LPRINT'APRIL';
00270 LPRINT TAB(20);X
00280 NEXT X
00290 END
00300 A=X-X/19x19:B=X/100:C=X-100xB:
      D=B/4:E=B-4xD:G=(8xB+13)/25
00310 Q=19xA+B-D-G+15:H=Q-Q/30x30:
      I=C/4:K=C-4xI
00320 Q=2xE+2xI-H-K+32:L=Q-Q/7x7
00330 M=(A+11xH+19xL)/433:
      N=(H+L-7xM+90)/25
00340 Q=H+L-7xM+33xN+19:P=Q-Q/32x32
00350 RETURN
```

EASTER SUNDAY

6	APRIL	1980
19	APRIL	1981
11	APRIL	1982
3	APRIL	1983
22	APRIL	1984
7	APRIL	1985
30	MARCH	1986
19	APRIL	1987
3	APRIL	1988
26	MARCH	1989
15	APRIL	1990
31	MARCH	1991
19	APRIL	1992
11	APRIL	1993
3	APRIL	1994
16	APRIL	1995
7	APRIL	1996
30	MARCH	1997
12	APRIL	1998
4	APRIL	1999
23	APRIL	2000

MORSE CODE TRAINING PROGRAM

```
01260 PRINT B1$:PLAY 0,5
01270 S=32+ASC(A0$):C0$=CHR$(S)
01280 IF B1$=A0$ OR B1$=C0$ THEN GOTO 1310
01290 IF C=2 THEN GOTO 1320
01300 CLS:PRINT:PRINT:PRINT:PRINT" WRONG TRY AGAIN":PLAY 0,10:C=C+1:GOTO 670
01310 CLS:PRINT:PRINT:PRINT:PRINT" CORRECT":PLAY 0,10:GOTO 520
01320 CLS:PRINT:PRINT:PRINT:PRINT" INCORRECT":PLAY 0,10:C=C+1:GOTO 670
01330 PRINT:PRINT A0$ ;" ";" IS CORRECT":PLAY 0,20:GOTO 520
01340 CLS:PRINT:PRINT:PRINT"MORSE TRAINING PROGRAM section 3 : five character
      groups":PLAY 0,20
01350 CLS:PRINT:PRINT:PRINT"five character group"
01360 A1$=""
01370 GOSUB 550
01380 GOSUB 690
01390 A1$=A1$+A0$
01400 IF LEN(A1$)=5 THEN GOTO 1420
01410 GOTO 1370
01420 W1$=""
01430 CLS:PRINT:PRINT:PRINT"THE GROUP WAS ????     "
01440 CURS 150:PRINT W1$
01450 W0$=KEY$
01460 IF W0$=CHR$(27) THEN GOTO 220
01470 W1$=W1$+W0$
01480 IF LEN(W1$)=5 THEN GOTO 1500
01490 GOTO 1440
01500 U=0
01510 FOR I=1 TO 5
01520 M0$=A1$(;I,I)
01530 N0$=W1$(;I,I)
01540 P=ASC(M0$)+32
01550 R0$=CHR$(P)
01560 IF N0$=M0$ THEN GOTO 1590
01570 IF N0$=R0$ THEN GOTO 1590
01580 U=U+1
01590 NEXT I
01600 IF U=0 THEN GOTO 1640
01610 CLS:PRINT:PRINT:PRINT:PRINT"NO YOU GOT IT WRONG THE GROUP WAS  ";
01620 UNDERLINE:PRINT A1$:PLAY 0,50:NORMAL
01630 GOTO 1350
01640 CLS:PRINT:PRINT:PRINT"YES THAT IS CORRECT":PLAY 0,20:GOTO 1350
01650 END
```

Step	Dividend	Divisor	Quotient	Remainder
1	X	19	—	A
2	X	100	B	C
3	B	4	D	E
4	8B+13	25	G	—
5	19A+B−D−G+15	30	—	H
6	C	4	I	K
7	2E+21−H−K+32	7	—	L
8	A+11H+19L	433	M	—
9	H+L−7M+90	25	N	—
10	H+L−7M+33N+19	32	—	P

In the Xth year AD of the Gregorian calendar, Easter Sunday is the Pth day of the Nth month.

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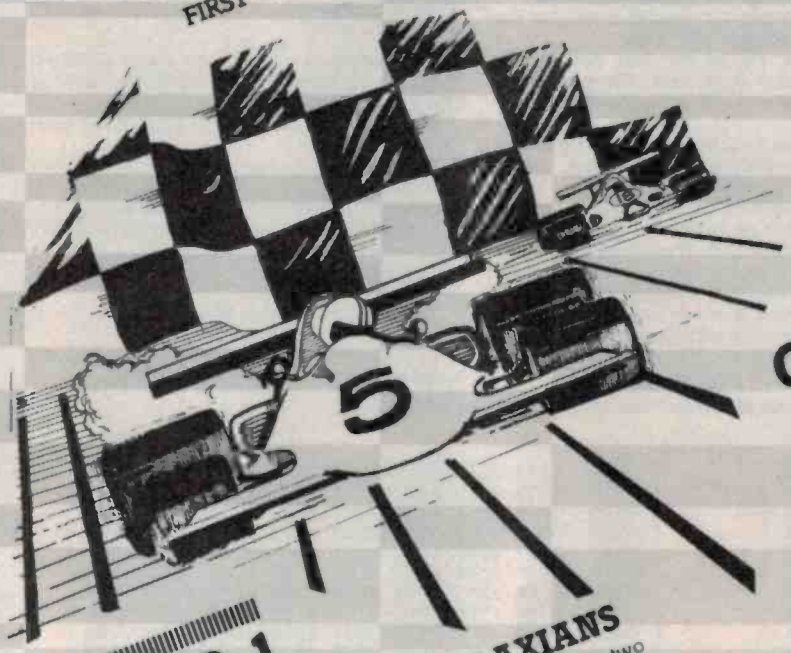

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MAZEGAZING

W. F. Kreykes, St Albans Victoria.

This program can only be run on a modified '660 which has a screen display of 64 x 64 pixels. See 'Experimenters modifications to the '660' in ETI, February 1984.

I have listed all the changes that I think players may wish to make. At this stage I suggest no other changes as the program is fairly complicated to follow or debug.

The listed colours give best results on a blue background, however, I have allowed for different combinations. The colours also provide an excellent picture on a black and white monitor, which is what I use for most of my work.

This program uses nearly three pages of MCSRs to make it run as fast as possible. Take a look at the CHIP 8 subroutine called from 07BC at 0880; if two guards collide with each other the routine calls a total of eight MCSRs.

Most of the machine code subroutines have been formed around specific actions of the operating system to make the program run even faster; in some cases the number of machine cycles has been cut in half and a great deal of memory has been saved.

What you must aim to do is travel every inch of the maze collecting the tokens as you go, while being careful to avoid being trapped by the guards that patrol the maze constantly. Skill and thought will enable you to use the charging cells to replenish your fuel, or obtain a bonus; carelessness will result in a wastage of fuel. If you successfully collect all the tokens you proceed to the next floor.

The aim is to get a higher score than your mate. Your score is displayed on the right and is updated at regular intervals. The highest score is shown on the left but this disappears to indicate a bonus opportunity. A timer governs the bonus opportunity and amount of bonus points in one case.

Unlike a cat, you only have five lives! Attempting to collect a fuel evaporation cell, without previously being charged, will result in a loss of fuel; but if you have already collected 380 tokens no loss of fuel is possible. You must collect tokens to conserve fuel.

The controls are: UP — 3; DOWN — B; LEFT — A; RIGHT — C.

Bonuses are subject to a time limit. When the high score box is violet you can attack a guard for a bonus of up to 250 points; this comes up at random.

When the high score box is black this means that you have just collected a charging cell and can now collect a fuel evaporation cell to obtain a bonus of fuel. You must not collect any tokens on the way and if your present fuel level is seven eighths or over a bonus of 150 points will be given.

When the high score box is yellow this means you have been doing some skillful driving by not colliding with anything while collecting 25 tokens; for this you get a bonus of 500. You now have the opportunity to attack a guard and if you do you can now repeat the above but you will only have to collect 15 tokens. But remember, one slip up and you are back to 25!

When all the tokens are collected proceed to the next floor with a bonus of 800 points.

A drawback is that as your lives dwindle, the guards increase and move faster. The game starts with three guards, ending with five guards patrolling the maze.

You have a lucky escape *only* when the high score box is violet when the guard seeks you out.

To start a new game press any key.

At the beginning of the game guards come out of the left-hand side of the homes and your men come out of the right-hand side. The homes have been designed so that once you come out it is impossible to go back in. There is no escaping the guards as they travel into every nook and cranny.

Note that most of the MCSRs directly modify the present value of registers 2, 3, 4, 5, 6, 8 & A of the 1802; register 5 is the program run register.

Before changes are made that are *not* listed below, ensure any MCSRs used are perused; if involved you must have an understanding of how the monitor works (original or modified).

The following addresses can have the value altered to between 0 and 7 to change the colour.

Red fuel and timer	0907
Green fuel line	091B
Colour of maze	092B
Bottom home G and M	093B
Fuel evaporators	0957
Display number men	0C59
Bonus of points	0877
Attack guard	08AB
Yellow fuel and timer	0911
Green timing line	0925
Top home guard and man	0931
Charging cells	0945
Your score box	0969
High score box	0A09
Collected charge cell	078B
25 tokens collected	080D

The background colour can be changed. Black is D4 at 0CCC; green is D4 at 0CCD; red is D4 at 0CCE; blue is D4 at 0CCF.

The rate of fuel wastage can be varied at 0E6E between 02 and 18.

The directional keys can be changed. Data at 0872 right; 0873 down; 0874 left; 0875 up. The number of the key must be preceded by a '1' for detectional purposes (by the MCSR). The data at 0D7D (the MCSR) must be the same as the data at 0872.

If you find the game is too hard try at 07BC a 00FF or a 275A to really move.

If you find that the game is too hard when down to your last life put a 00FF at 09BC.

To change the tune at the start of the game and when a life is lost try changing V2 at 0A4A.

If anyone has trouble with this program please feel free to contact Bill on (03)366-1324.

MAZEGAZING

```
0700 0CBD AEBC F465 A487 F455 1718 00E0 0B28
0710 A400 F465 A487 F455 6005 AD0C F055 6000
0720 6101 6200 AE90 D122 7101 3140 1726 AE8E
0730 F155 AEBC F465 A400 F455 2900 0C55 AE9A
0740 0B4C 2A6A AEBC F465 ADF0 F455 F455 F455
0750 A480 608E 6101 F155 1994 0860 E3A1 6300
0760 E2A1 6318 E1A1 6308 E0A1 6310 0D78 D783
0770 0D8A D783 0DAB D782 0C70 D782 00EE D783
0780 0D39 D783 00EE 3908 0C90 6000 611E 6901
0790 28B0 0C9E 4E07 2A06 3E07 2B08 6B50 0871
07A0 2876 FD00 FD18 7DFB 3D1E 17A2 0BE8 173C
07B0 00FF 65F0 6908 2880 0E36 2A60 2880 275A
07C0 2880 0E67 D232 2880 2880 275A 2880 4908
07D0 17B6 AD06 633F DE31 7EFF 601F 80E5 4F01
07E0 7BFF 3E07 17B6 28C6 2A06 2B16 6908 17BE
07F0 00FF 00FF 1AC8 1AF4 2B16 28C6 1B40 6B32

0800 61BB 28B0 2A7E 0BE8 28C6 2B16 6005 613C
0810 287A 6902 0C9E A480 F165 3100 1826 6110
0820 8105 3F00 0C9E 0E33 2A10 60C1 F000 610F
0830 287A FD18 AE8F F065 6300 70FF 4000 17F8
0840 D032 7301 3340 1842 7101 3112 1838 AE8F
0850 F055 17E6 3902 1816 2B08 2A06 6908 1816
0860 93BA F872 AAF8 73A6 E64A 734A 734A 730A
0870 56D4 1C1B 1A13 6004 61BB A490 F155 18C6
0880 0D96 D124 0D20 D124 0DC7 D124 0D4A D124
0890 0DC7 D124 0D43 D124 0DC7 D124 6200 2A68
08A0 3908 00EE C908 3900 1B16 6003 612D 6E19
08B0 6E37 2A0A 633F AD14 6008 F000 F018 D031
08C0 7002 3038 18EA 0C00 41AA 1A10 AB89 41BB
08D0 1A6E F11E F21E D3D5 7308 3320 18D4 00EE
08E0 4908 19EA 4901 19EA 289A 6308 8303 5360
08F0 1AFC 4902 1DEA 2B08 2876 0BE8 2A7E 17E6

0900 6A19 6D1E ACF0 6001 0C47 AEE1 0C44 ACF1
0910 6005 0C1C AEC2 0C19 ACF3 6004 0C1C ACF5
0920 0C19 AEC4 6004 0C1C AED7 6003 0B75 AD92
0930 6005 0C47 0C47 0C47 AE22 6007 0C47 0C47
0940 0C47 AD11 6007 0C47 ADB6 0C44 AE81 0C44
0950 AE95 0C44 AD82 6000 0C47 AD45 0C44 AE45
0960 0C44 AEC1 0C44 ADDC 6007 0C1C 6000 61FF
0970 A7B6 F155 A7C0 F155 A7CC F155 00EE 0D80
0980 D783 4E07 2A10 3E07 2B08 AD0C F065 70FF
0990 AD0C F055 AD09 F365 4300 1B40 60F6 4302
09A0 60F3 4301 60F0 A7B3 F055 ADE6 F055 A7C6
09B0 F165 4303 A7CC 4302 A7C0 4301 A7B6 F155
09C0 6004 4302 6006 4301 6008 AE3D F055 AE92
09D0 F055 2B24 2A06 6600 AD05 6816 CF01 3F00
09E0 6828 6714 D783 6E07 17B4 2A68 2B16 60B0
09F0 F000 F018 F015 F007 3060 19F6 197E 6B0F

0A00 61BB 0BE8 1AEA 61AA 6006 A490 F155 0C00
0A10 A487 6C1A F465 F429 DCD5 7CFC F329 DCD5
0A20 7CFC F229 DCD5 7CFC F129 DCD5 7CFC F029
0A30 DCD5 00EE 2A36 8030 AD05 610A 621F D123
0A40 70FF 7104 3000 1A3E 6050 6206 F000 F218
0A50 F215 F207 3200 1A52 70F0 3010 1A4A 00EE
0A60 CF01 3F00 6228 D124 0DCA 2B1A 1A48 D3D5
0A70 A48C FB33 A48D F165 6200 6C19 1A22 6000
0A80 6103 0C13 CF7F FF00 F118 7101 3120 1A8A
0A90 7001 3005 1A80 00EE 6C34 1A14 00F8 6B50
0AA0 F900 F918 2AB6 E3A1 170C 7301 3370 1AA6
0AB0 2AB6 89B3 1AA4 3900 1A08 0C55 ABD9 6205
0AC0 6308 F318 0C6F 18D6 3901 1854 2B08 AE8F
0AD0 F065 8100 7008 6340 8305 3F01 19FE AE8F
0AE0 F055 6300 AFB6 D132 6100 287A 2A7E 28C6
0AF0 2B16 1AF6 2B08 2A06 6908 0C9E 3900 19EA
```

MAZEGAZING

```
0B00  2B08 FC00 FC18 17E8 AD06 633F DE31 7EFF
0B10  3E07 1B0C 18C6 A482 2A98 A400 2A98 A482
0B20  F455 00EE 0C55 1A34 F887 A7E7 F800 A686
0B30  FF05 323B 46F5 3B3E 1732 2FF8 18A5 D400
0B40  00FC 6950 7901 3950 1B44 1A9C F805 BBBC
0B50  F8F0 ABF8 08BF 4A5B 1B8B FFF8 3A56 F8E7
0B60  AC9F AF1C 4A5B 5C1B 2F8F 3A63 8CFF 10AC
0B70  FFFF 3A61 D4EA 0AAC 065A 632A 8C73 8AFF
0B80  073A 769A FF7D 3A76 D408 083E 0808 0312
0B90  3B12 02AB 2A2B 2A3B A020 2020 B803 023B
0BA0  0202 AB2A 2B2A 3BA0 2020 20B8 0339 2139
0BB0  03D1 51D1 51DD 2040 8840 2000 3B21 3B00
0BC0  08DC 08C2 0A08 28A8 A8A8 2A00 3B21 3BA9
0BD0  01C9 01C9 3820 3808 3824 243C 2424 9E90
0BE0  9692 9E48 4878 4848 F87B A606 AF8F 3274
0BF0  2FF8 03A6 06FC 0156 FF0A 3AED 5626 30F4

0C00  F870 A6F8 90A7 4756 1607 5616 F805 5616
0C10  F808 56F8 0DBA F8D9 AAF8 70A6 EAF8 06AE
0C20  F823 AF30 3330 3330 331A 1A1A 1A1A 2E8E
0C30  3A20 D40A AC06 5A63 2A8C 5A1A 1F1F 8FA3
0C40  F8F4 A5D4 F870 A6EA 0AAC 065A 632A 8C5A
0C50  8AFC 10AA D4F8 70A6 F804 5630 1342 B542
0C60  A5D4 2606 FF08 3A99 16F8 1956 F8FE A5D4
0C70  4632 EC06 FF01 563A 7F16 0632 E6F6 56F8
0C80  78A6 F8F0 AF93 BFE6 4FF5 32D0 1F8F 3A88
0C90  E6F8 7AA6 91F5 3262 7306 FF08 3AE2 E282
0CA0  2252 6491 A8F8 0EBF F88E AF0F FC02 5F96
0CB0  A606 FC01 56FF 0A3A 5D56 2630 B1F8 39A6
0CC0  E6F8 2C56 6226 F820 5662 E961 6161 61D4
0CD0  26F8 F8F2 EFF5 E63A 908F FA08 3A40 F886
0CE0  A5D4 F8F6 A5D4 12F8 9473 307F F87A A5D4
0CF0  0408 1830 3208 3428 0A28 1210 2A28 3A08

0D00  3C08 3C00 40E0 80E0 7820 7800 00E0 20E0
0D10  2838 2828 C0A0 A0E0 2828 3828 00E0 A0A0
0D20  F870 A6F8 FEAC E646 3233 FF08 3235 16FF
0D30  0832 359C 388C F456 D49C ACF8 FEBC F876
0D40  A630 26E6 F808 ACF8 00BC F870 A6F8 72A7
0D50  06FF 103A 5907 FC01 579C 326B 06FB 10AC
0D60  E999 F4E6 F4E9 56F8 08F2 568C F356 AAFF

0D70  103A 7707 FF01 57D4 F873 A606 FF1C 32B4
0D80  F876 A606 FC05 AA93 BAD4 F873 A646 1616
0D90  56FC 05AA 3023 93BA F875 A606 AA4A 32DD
0DA0  2626 26E6 734A 730A 56AA D406 3ABD F879
0DB0  A606 3AB9 42B5 42A5 D4F8 03AA D4F8 7AA6
0DC0  F819 56F8 7EA5 D406 3AFF F875 A606 FC02
0DD0  AAF8 70A6 EA46 7346 7346 5A16 1606 FC03
0DE0  56FF FF3A B4F8 F056 30B4 2A7E 6A0F 1B00
0DF0  ---- ---- ---- ---- ---- ---- ---- --F8

0E00  72A6 F878 A7E6 07AF F532 1C1F 8FF5 321C
0E10  1F8F F532 1C07 FF02 F532 1CD4 E726 2706
0E20  F532 3006 FC02 F532 3006 FC04 F532 30D4
0E30  F8E0 A512 12D4 93BF F892 AF0F FF02 5F3A
0E40  74F8 0DBA F8E6 AA0A AA0A 3256 1A1A 1A8A
0E50  FFFF 3A49 3074 F875 A6E6 8A73 2626 1F4F
0E60  734F 730F 56AA D493 BAF8 8EAA 0AFF 105A
0E70  FAF0 3277 1515 D45A F872 A61A 0AFF 0156
0E80  5A32 961A 2252 649C A816 F800 56D4 0040
0E90  8080 0016 1008 F8F8 A5D4 447F FFFC 1FFF
0EA0  FF11 557F FFFC 1FFF FF55 447F FFFC 1FFF
0EB0  FF11 557F FFFC 1FFF FF55 4400 0000 0000
0EC0  0011 513F FFF9 4FFF FE55 4001 8100 0040
0ED0  0011 5554 FF55 5555 5555 4000 1C00 0040
0EE0  0011 7974 3C5D 5D13 F4F5 4050 1C14 1400
0EF0  1001 5574 FF5D 5D55 5555 4040 001C 1C00

0F00  1001 5115 5555 5D7F 544F 4400 001C 145D
0F10  1101 5557 FFFD 5D7F 4555 4404 0014 0000
0F20  0101 5791 555D 5555 55F5 4000 0000 0000
0F30  0011 5555 7455 5FFF F555 4000 5100 1000
0F40  1011 513F F54F F555 5F55 4400 0100 1000
0F50  1511 5555 5555 55FE 5B55 4400 0100 1140
0F60  1511 57FE 45E4 45D5 5F45 4000 1001 0000
0F70  0001 5555 5555 5557 5555 4000 1001 0007
0F80  0001 7FFF FFFF FFFF FFFF.
```

notes; This game only suitable for the '660 with a modified 64x64 display.

"----" = DATA area, also 0480-0491

DATA underlined set by program run.

RANDOM WARBLER

Tim Parish, Myrtle Bank SA

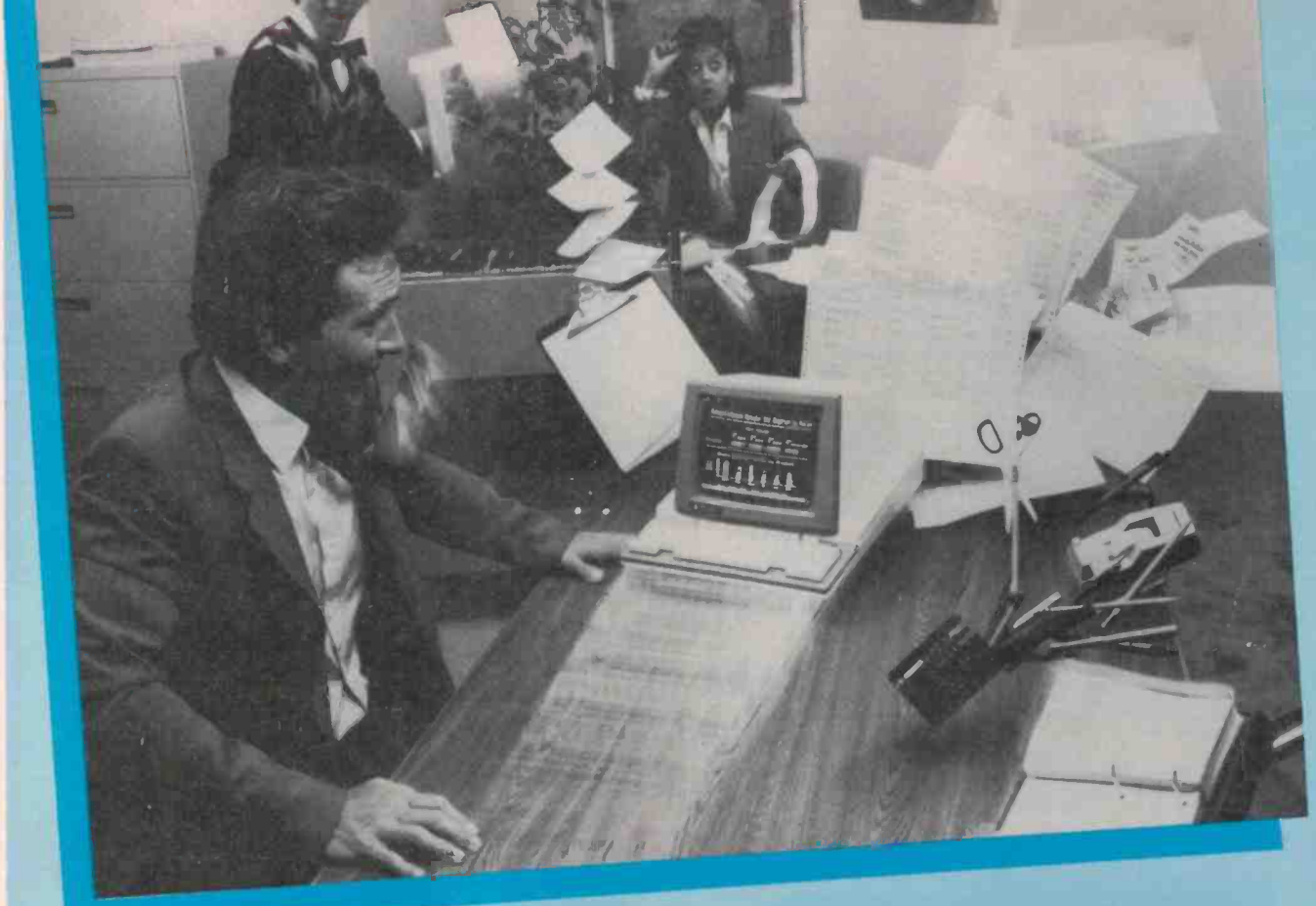
This purely audio program will either fascinate you for hours or drive you around the bend! It gives the tone generator a real workout, producing a sliding, oscillating, chopped sound that behaves according to the following random variables: (VE) starting pitch, (VC) number of pitch increments in either direction, (VB) pitch increment, (V7) length of rests between beeps, (VD) time interval before next set of random quantities is generated.

VA and V8 are counters used in the range of oscillation and rests between beeps, respectively.

Many other effects can be obtained by holding some random variables constant or changing their maximum values e.g: CC2F or CC0F.

RANDOM WARBLER

```
      0600 V9=01          6901
#1    0602 V7=RND AND 1f  c71f
      0604 VE=RND AND ff  ceff
      0606 VD=RND AND 7f  cd7f
      0608 VC=RND AND 2f  cc2f
      060A V8=RND AND 0f  cb0f
      060C V8=V8+f8       7bf8
      060E VA=00          6a00
      0610 TIME=VD        fd15
#2    0612 PITCH=VE       fe00
      0614 TONE=V9        f918
      0616 V8=ff          68ff
#3    0618 V8=V8+01       7801
      061A SKF V8=V7      5870
      061C GOTO #3        1618
      061E VE=VE+V8       8eb4
      0620 VD=TIME        fd07
      0622 SKFN VD=00     4d00
      0624 GOTO #1        1602
      0626 VA=VA+01       7a01
      0628 SKF VA=VC      5ac0
      062A GOTO #2        1612
#4    062C PITCH=VE       fe00
      062E TONE=V9        f918
      0630 V8=ff          68ff
#5    0632 V8=V8+01       7801
      0634 SKF V8=V7      5870
      0636 GOTO #5        1632
      0638 VE=VE-V8       8eb5
      063A VD=TIME        fd07
      063C SKFN VD=00     4d00
      063E GOTO #1        1602
      0640 VA=VA+ff       7aff
      0642 SKFN VA=00     4a00
      0644 GOTO #2        1612
      0646 GOTO #4        162c
```



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Introducing a desktop revolution. The Personal Terminal from TeleVideo® — a compact new terminal for people who've forgotten what the finish on their desktops looks like. It isn't intimidating. It doesn't require programming knowledge. And it costs much less than a full-sized terminal. Clearly, the Personal Terminal will simplify the way your company works.

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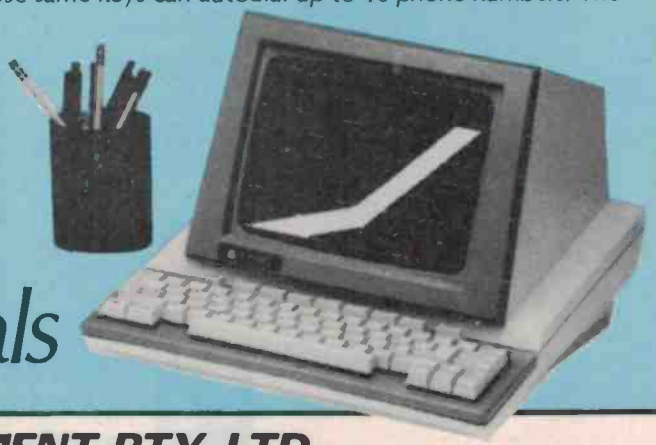
The Personal Terminal from TeleVideo. The desktop connection to a more intelligent, productive and cost-effective office environment. Isn't it time you got in on the information management boom?



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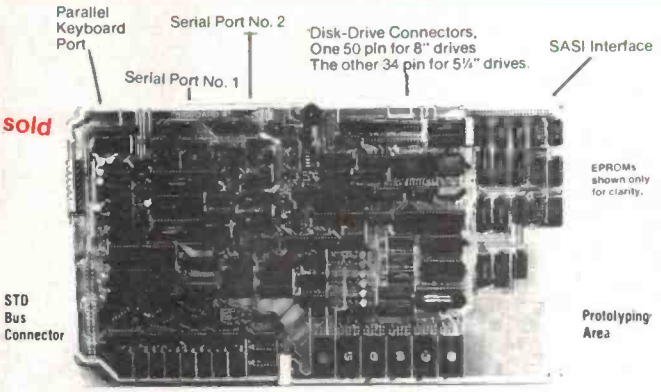
"BIG BOARD II"

Over 1,000 sold



Jim Ferguson, designer of the "Big Board" distributed by Digital Research Computers, has producing a stunning new Computer, "Big Board II". It has the following features:

4 MHz Z80 - CPU AND PERIPHERAL CHIPS

The Ferguson computer runs at 4 MHz. Its monitor code is lean, uses Mode 2 interrupts, and makes good use of the Z80-A DMA chip.

64K DYNAMIC RAM + 4K STATIC CRT RAM + 24K E(E)PROM OR STATIC RAM

"Big Board II" has the three memory banks. the first memoery bank has eight 4164 RAMs that provide 60K of user space and 4K of monitor space. The second memory bank has two SKx8 SRAMs for the memory-mapped CRT display and space for six 2732 As, 2Kx8 static RAMS, or pin-compatible E(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 450 nS2732A EPROM containing the monitor.

MULTIPLE-DENSITY CONTROLLER FOR SS/DS FLOPPY DISKS

The new Ferguson single-board computer has a multiple-density disk controller. It can use 1793 or 8877 controller chips since it generated the signal with TTL parts. The board has two connectors for disk signal with 34 pins for 5.25" drivers, the other with 50 pins 8" drives.

VASTLY IMPROVED CRT DISPLAY

The new Ferguson SBC uses a 6845s CRT controller and 8002 Video Attributed controller to produce a display that will rival the display of quality terminals. Characters are formed by a 5x7 dot matrix on 15.75 KHz monitors and 7x9 dot matrix on 15.75 KHz monitors. The display is user programmable with the default display 24 lines of 80 characters.

STD BUS CONNECTOR

The Ferguson computer brings its bus signals to a convenient place on the PC board where users can solder an DSTD, 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 Z80-A CTCs = EIGHT PROGRAMMABLE COUNTERS/TIMERS

The new Ferguson computer has two 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

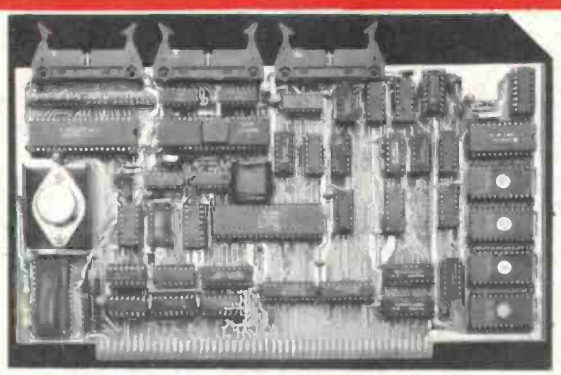
The new Ferguson SBC has circuitry and drivers for programming 2716s, 2732(A)s, or pin-compatible (E)EPROMs. Software $25 extra.

CP/M

CP/M with Russell Smith's CBIOS for the new Ferguson computer is available for **$295**
The CBIOS is available separately for $65.
Actual board size: 39.6cm x 22.2cm. 5 inch BIOS being developed. Approx price $95.

Kit Price
$695 inc. tax
$850 Assembled and Tested

S100 CPU Card

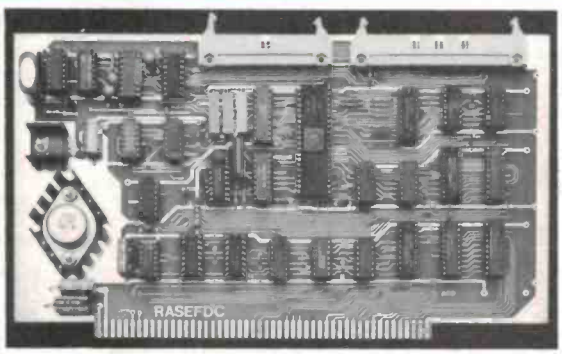


GENERAL DESCRIPTION:

- Z80A CPU running at a full 4 MHz
- Battery backed real time clock and calendar
- 2K of CMOS ram as standard
- 2716/2732 Eprom from 2K to 16K
- Z80A CTC with all 4 channels available to user
- 2-RS232 serial ports available
- Software controlled baud rates on each channel
- 16-baud rates from 50-192200 baud available
- 3-8 bit parallel ports via an 8255A
- Centronics compatible printer port via 8255A
- DMA operations supported
- Power on jump to any 4K boundary in memory
- On board memory enable/disable for full 64K operation
- Vectored interrupt chain via Z80 CTC
- Daisy chain interrupts through system full supported
- Comprehensive 2K monitor available
- Complemented by Disk, Memory and Input/output cards
- Local software and hardware support available
- A QUALITY AUSTRALIAN PRODUCT

Bare Board $180 & tax
Kit Price $295 & tax
Assembled & Tested $350 & tax
Manual Available Separately for $15 inc. Postage.

S100 Floppy Disc Controller



GENERAL DESCRIPTION

The extensive capabilities of the rasefdc are to a large part due to the presence of the Western Digital WD1795 double density controller chip. This device will perform the majority of the timing and control functions as required by floppy disk drives when carrying out the following operations.

1. Head loading and unloading
2. Track seeking
3. Address reading and writing
4. Data conversion during read and write
5. IBM3740 soft sector compatibility
6. CRC error code inspection generation
7. Double density write precompensation.

The board uses the phase locked loop technique when recovering data from disk. the vco of the phase locked loop is under the control of the WD1691 circuit to ensure very reliable data recovery during double density operations. To ensure syncronism between the CPU and the controller card during disk read and write operations the rasefdc will inset wait states until the WD1795 is ready to pass or receive the next byte of data.

Bare Board $150 & tax
Kit price $295 & tax
Assembled & Tested $350 & tax
Manual Available Separately for $12 inc. Postage.

Prices subject to change without notice

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RECEIVER IS A RADIO CONTROLLED SWITCH

Telmar Communications has released its Teltrac receiver, an applications-agile radio controlled switch. This receiver is designed to replace expensive cable runs in environments where process controlled switching is done centrally.

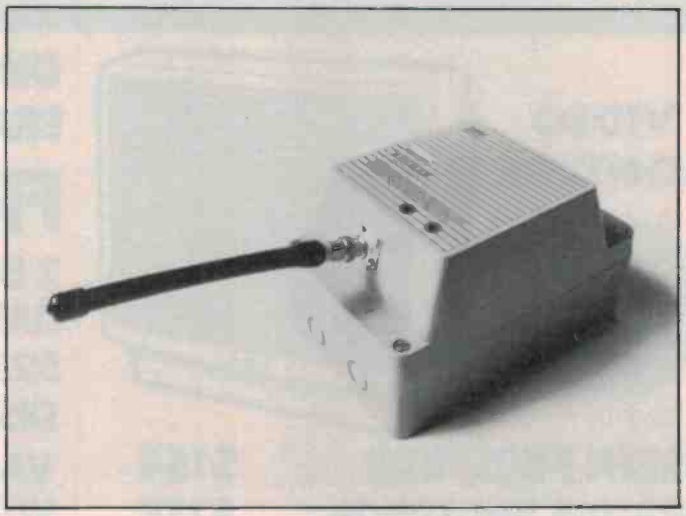
The Teltrac may also perform a number of pre-programmed switching sequences which will help to distribute the controller's work load.

The Teltrac receiver can be supplied on practically any frequency, including 27 MHz and up to 520 MHz. Coding structure is also extremely flexible, however, 2/5 tone sequential is preferred.

The Teltrac may operate on an existing company channel on an overlay basis or, if air-time becomes excessive, a discrete frequency can often be arranged.

Telmar advise that the Teltrac can even be supplied on Telecom's Telefinder network. In this case the Teltrac is seen as a pager offering two addresses and a group call function. Thus a user may remotely turn on/off almost any electrical device they wish.

Enquiries on this receiver may be directed to the **National Sales & Marketing Manager, Telmar Communications, 604 City Rd, Sth Melbourne Vic. 3205. (03) 690-8666.**



3½-DIGIT MANUAL/AUTO MULTIMETER

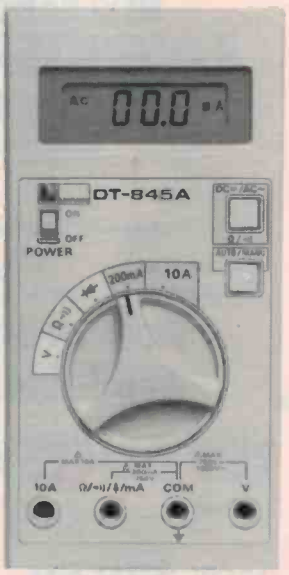
The latest model in Univolt's digital multimeter line-up, the DT-845A, features a 3½-digit liquid crystal display and operator selectable autoranging or manual operation.

There are five dc voltage ranges: 200 mV full-scale, 2 V, 20 V, 200 V and 1 kV. Accuracy is quoted as 0.5% + two digits on the lowest range and 0.7 + one digit on the other ranges. There are four ac voltage ranges from 2 V to 750 V, accuracy being quoted as 1% + five digits.

There are five current ranges of 200 μA, 2 mA, 20 mA, 200 mA and 10 A. Accuracy on dc is quoted as 1.2% + one digit and on ac as 1.5% + five digits.

Six resistance ranges cover 200 ohms to 20M, with an accuracy given as 0.8% + two digits on the lowest range, 0.8% + one digit on the 2k to 200k ranges, 1% + two digits on the 2M range and 2% + two digits on the 20M range. A continuity beeper is included and a separate diode test function.

The auto/manual button permits operator selection of autoranging or manual operation on the volts and resistance functions. The 14 mm high display shows the mode of operation, range and polarity of the measurement, along with the value.



Further enquiries should be directed to **Benelec Pty Ltd, P.O. Box 21, Bondi Beach NSW 2026. (02)665-8211.**

WAVEFORM MEASUREMENT SOLUTIONS

Hewlett-Packard has published a new full colour brochure which details the HP 1980 oscilloscope measurement system and its role in automatic test systems.

Titled "Waveform Measurement Solutions Through HP Automation" (Publication No. 5953-3933), this brochure discusses how measurement quality and throughput can be increased in production, calibration laboratories, new-product development and incoming inspection.

The brochure provides guidelines for developing a testing strategy based on a test system in an automatic environment. Included are examples of some of the most common measurements a user can make with the HP 1980 system as well as some of the problems that the system can solve.

It also discusses the concept of the manufacturer's productivity network (MPN), and how such a network can be used to increase overall productivity.

Included are details on the function and performance of the measurement tools of the HP 1980 system, which includes a fully programmable oscilloscope, gated universal counter, digitiser, programmable analogue comparators and application software.

For more information contact **Hewlett-Packard Australia Ltd, 31-41 Joseph St, Blackburn Vic 3130. (03)895-2895.**

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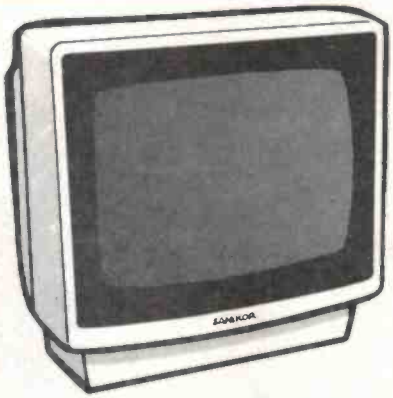

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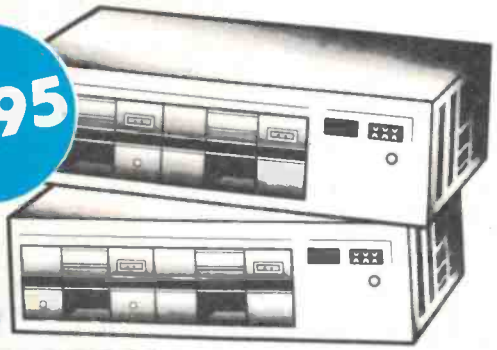

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NEW HIGH PERFORMANCE UHF BIPOLAR TRANSISTORS FROM H-P

Many low-cost, high-performance amplifier and oscillator design needs can be met with a new family of NPN bipolar transistors introduced by Hewlett-Packard, according to company literature.

These new products were developed specifically for use in radar, ECM and communications applications where low noise figure, high gain and highlinear output power performance considerations are important.

Each silicon transistor consists of one chip and four metal/ceramic package selections, each characterised for optimum performance.

The HXTR-7011 is a big-pad chip usable in most high-performance amplifier and oscillator applications.

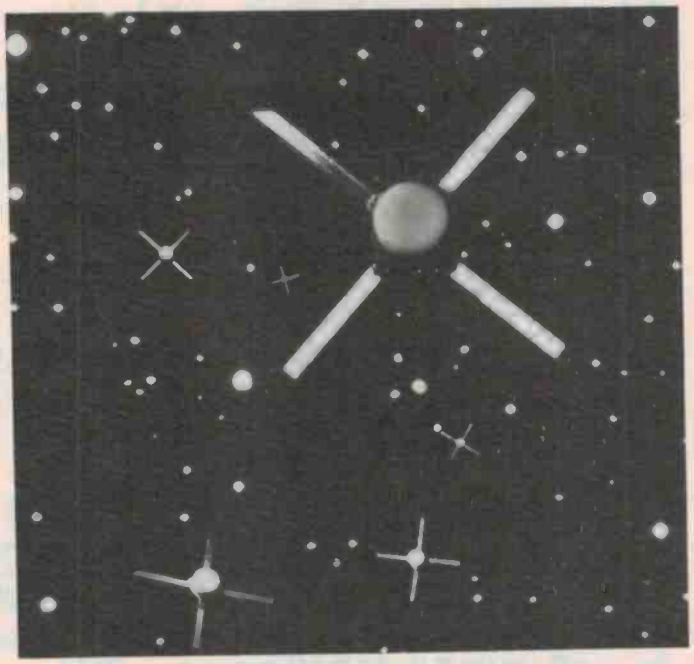
Hermetically sealed, the HPAC-100X packaged transistors are the HXTR-3615, HXTR-3645, and HXTR-3675, which are usable from 100 to 5000 MHz with typical noise figures of 1.2 dB to 3.5 dB and associated gain of 17.7 dB to 7.0 dB over this frequency range, H-P claim.

The HXTR-7111 is supplied in the hermetically sealed HPAC-100 with typical noise figures of 1.2 dB to 2.8 dB and associated gain of 18.5 dB to 8.7 dB over the frequency range of 100-4000 MHz, according to the company literature.

To achieve consistent device-to-device uniformity and reliability, HP's manufacturing process uses self-alignment, ion-implantation techniques and tiW metallization.

The chips have dielectric scratch protection over the active area.

For pricing and delivery contact Hewlett-Packard's Sales offices and authorised distributors, **VSI Electronics** and **STC-Cannon Components.**



MAGNETO RESISTIVE SENSOR

A new magneto-resistive sensor from Philips measures both linear and angular displacement, and offers several advantages over conventional Hall-effect devices, particularly in hostile environments.

Designated the KMZ10, it detects small variations of magnetic field at frequencies from dc to several megahertz, providing a proportional linear output signal over a temperature range of −40 to +120 °C.

Used in conjunction with permanent magnets, the KMZ10 translates these magnetic variations into measurements of linear or angular displacements ranging from a few millimetres up to tens of centimetres, with a resolution down to one micrometre.

The device is a Wheatstone-bridge arrangement using thin film permalloy resistors on a silicon substrate for measurement and offset compensation, giving high accuracy and long term stability. It is a remote position sensing device, and is therefore suitable for both instrumentation and control equipment, electronic ignition systems, gas and oil level monitoring and other automotive applications.

The KMZ10 is the first of a series of magneto-resistive position sensors and is available in four versions with sensitivities of 2.7 μVm/A, 2.5 μVm/A, 0.43 μVm/A, and 0.06 μVm/A.

For information contact **Philips Electronic Components and Materials, 67 Mars Road, Lane Cove, 2066. (02)427-0888.**

ZILOG'S CMOS Z80 CIRCUITS

Zilog Inc. has announced plans to produce CMOS versions of its Z80 eight-bit microprocessor and four peripheral support circuits based on an advanced CMOS process developed by Toshiba.

The five circuits, to be available in sample quantities beginning in mid-1984, are the result of a technology-exchange agreement signed by the two companies in June 1982.

The agreement called for Zilog to transfer to Toshiba designs for its Z80 NMOS family, and for Toshiba to design CMOS versions of those products and provide Zilog with those designs along with its CMOS fabrication process. Both companies will have worldwide marketing rights to the parts.

The 2.5 micron p-well CMOS process from Toshiba is now being implemented at Zilog's Technology Development Center in Cupertino, Calif..

The five devices to be manufactured by Zilog include CMOS versions of the Z8400 CPU (the Z80 microprocessor, 2.5 and 4.0 MHz version), the Z8420 Parallel Input/Output Controller, the Z8430 Counter/Timer Circuit, the Z8440 Serial Input/-Output Controller, and the Z8420 Direct Memory Access Controller.

David J. Guzeman, Zilog's vice president of marketing and strategic planning, said the acquisition of Toshiba's proven CMOS process and the resulting Z80 family parts will enable Zilog to target applications with critical requirements for low power, high speed and minimum noise susceptibility.

Further information may be obtained from Zilog's representative in Australia **Z Systems Pty Ltd, 196b Vulture St, South Brisbane Qld 4101. (07)44-3715.**

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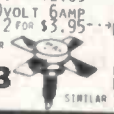

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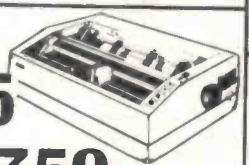

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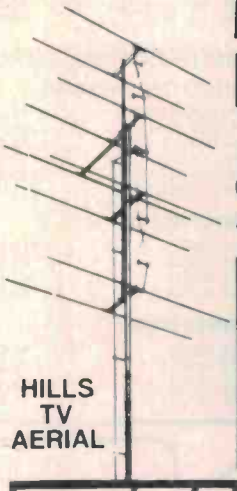

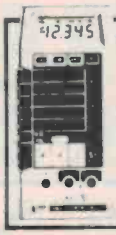

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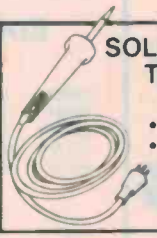

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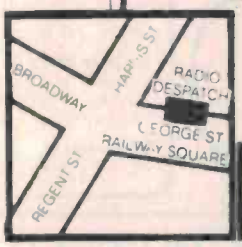

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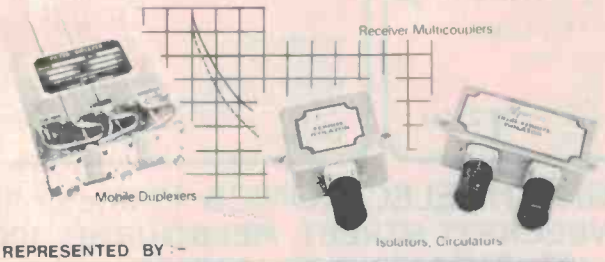

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FRC2-A40	40 WAY SOCKET	$3.43
FRC2-A50	50 WAY SOCKET	$4.01
FRC2-A60	60 WAY SOCKET	$4.61

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FRC-D14	14 PIN	$1.38
FRC-D16	16 PIN	$1.49
FRC-D20	20 PIN	$2.03
FRC-D24	24 PIN	$2.24
FRC-D40	40 PIN	$2.59

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14 WAY	$1.49	15 WAY	$1.09
15 WAY	$1.58	20 WAY	$1.36
16 WAY	$1.70	24 WAY	$1.59
20 WAY	$2.13	25 WAY	$1.70
24 WAY	$2.55	26 WAY	$1.77
25 WAY	$2.66	34 WAY	$2.27
26 WAY	$2.77	37 WAY	$2.42
34 WAY	$3.09	40 WAY	$2.59
36 WAY	$3.26	50 WAY	$3.20
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IC 1-2	230	180	80	$26.40
IC 1-3	300	230	105	$38.01
IC 2-1	160	110	55	$8.23
IC 2-2	200	140	70	$10.95
IC 2-3	270	220	90	$18.24
IC 2-4	330	230	100	$23.95

EDDYSTONE DIECAST BOXES

7969P	92.1 mm	38.1 mm	27 mm	$3.61
6908P	119.1 mm	93.6 mm	52.4 mm	$5.83
6827P	187.7 mm	119.5 mm	52.4 mm	$9.32
6357P	187.7 mm	119.5 mm	77.8 mm	$12.35
9970P	187.3 mm	187.3 mm	63.5 mm	$21.74

HORWOOD

H84/17V	430 mm	210 mm	100 mm	$18.89
H84/12V	305 mm	210 mm	100 mm	$15.71
H84/10V	255 mm	210 mm	100 mm	$14.51
H84/12V	305 mm	210 mm	100 mm	$16.78
H84/10V	255 mm	210 mm	100 mm	$15.42
H84/6V	150 mm	210 mm	100 mm	$13.37
H93/12V	305 mm	224 mm	75 mm	$15.90
H93/10V	255 mm	224 mm	75 mm	$12.79
H34/1/D	100 mm	25 mm	75 mm	$3.15
H34/2/D	100 mm	50 mm	75 mm	$3.30
H34/3/D	100 mm	75 mm	75 mm	$4.46
H34/4/DS	100 mm	100 mm	75 mm	$4.85
H34/6/DS	100 mm	152 mm	75 mm	$5.42
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H34/10/DS	100 mm	255 mm	75 mm	$8.11

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225F-A34	34 WAY	$5.17
225F-A40	40 WAY	$5.57
225F-A50	50 WAY	$6.44

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225D-10043	43 WAY DOUBLE SIDED	$10.20
225D-10050	50 WAY DOUBLE SIDED	$11.62

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225 x 150mm	SINGLE SIDED	$4.26
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75 x 150mm	SINGLE SIDED	$1.24

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14 PIN	29c
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24 PIN	47c
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40 PIN	76c

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1.60 mm	60/40	$10.80
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The Shuttle 300 is a basic modem, relying on a telephone for dialling and answering calls. However it does provide the full 12V bipolar output signals required by RS-232C for reliable operation with computers and terminals. The RS-232 connector also provides "Carrier detect" and "clear to send" outputs and uses "Data Terminal ready" and "request to send". Three front panel led's provide visible indication of carrier detect, receive data and transmit data status, while a fourth led is used as a power on indicator.

The "Voice/Data" switch allows selection of telephone or modem operation. An "Answering/ Origin" switch allows either answer or orighate mode of operation.

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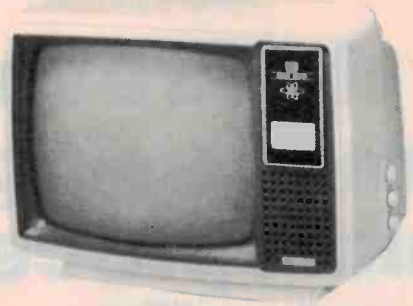

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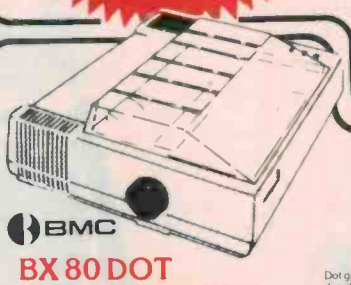

BMC

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Printing method:	Serial impact dot matrix.
Printing format:	Alpha-numeric – 7 x 8 in 8 x 9 dot matrix field. Semi-graphic (character graphic) 7 x 8 dot matrix. Bit image graphic – Vertical 8 dots parallel, horizontal 640 dots serial line. Superscript and bit image graphics – Unidirectional, left to right.
Character set:	228 ASCII characters. Normal and italic alpha-numeric fonts, symbols and semi graphics.
Printing Speed:	80CPS, 640 dots/line per second.
Printing direction:	Normal – Bidirectional logic seeking.
Dot graphics density:	Dot graphics density up to 1280 dots per line.
Columns/line:	Ribbon: cartridge type. Normal size – 80 columns. Double width – 40 columns. Compressed print – 142 columns. Compressed/double width – 71 columns. The above can be mixed in a line.
Paper feed:	Adjustable sprocket feed and friction feed.
Paper type:	Fanfold Single sheet. Thickness – 0.05mm (0.002") to 0.25mm (0.01"). Paper width – 101.6mm (4") to 254mm (10").

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SPECIFICATIONS:

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- N-key rollover with auto repeat capability.
- 4 LED indicators for caps lock, on-line, block mode and keyboard lock/protect.
- Audible keyclick enable/disable.
- Auto repeat enable/disable.
- Keyboard lock enable/disable.
- Repeat rate 20 characters per second.
- 5 cursor control keys, 10 editing function keys with 14-key numeric key-pad.

Communication
- Code: 128 ASCII characters.
- Baud rate: 75, 110, 150, 300, 600, 1200, 1800, 2400, 4800, 9600, 19,200.
- Parity: Odd, even, mark, space.
- Operating Mode: Full duplex, half duplex or block mode.
- Interface: EIA RS-232C or 20-mA Current Loop.

Emulation
- LEAR SIEGLER ADM-3A, HAZELTINE 1500, ADDS VIEWPOINT.

Screen Presentation
- Display format: 24 lines x 80 characters.
- Display unit: 12-inch, non-glare Green CRT.
- Character type: 7 x 9 dot matrix.
- Refresh rate: 50/60 Hz.
- Character set: 96 ASCII characters, 51 graphic symbols, 32 control character symbols.
- 5 screen attributes: Blink, underline, blank, reverse, dual intensity.
- Cursor type: Selectable slow, fast blinking or steady cursor, block, underline or invisible cursor.

Editing Function
- Cursor: up, down, left, right, home.
- Insert character, delete character, insert line, delete line, erase to end of line, page and field, field tab, field back tab, column tab, column back tab, block mode on/off, protect mode on/off, graphic mode on/off, clear unprotected.

External Control
- Power on/off.
- Contrast adjustment.
- Baud rate.
- Parity and data format
- End of message.
- Emulation mode.
- Refresh rate.
- Half duplex or full duplex.
- Auto line feed.
- Auto new line.
- EIA or 20-mA Current Loop.
- Reverse video or standard video.

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SUPER LOW PRICE
$6.32
5mm LED's RED, YELLOW, GREEN
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MD-1D	SSDD	5¼"	$45.77
MD-2D	DSDD	5¼"	$52.73
FD-1	SSSD	8"	$46.57
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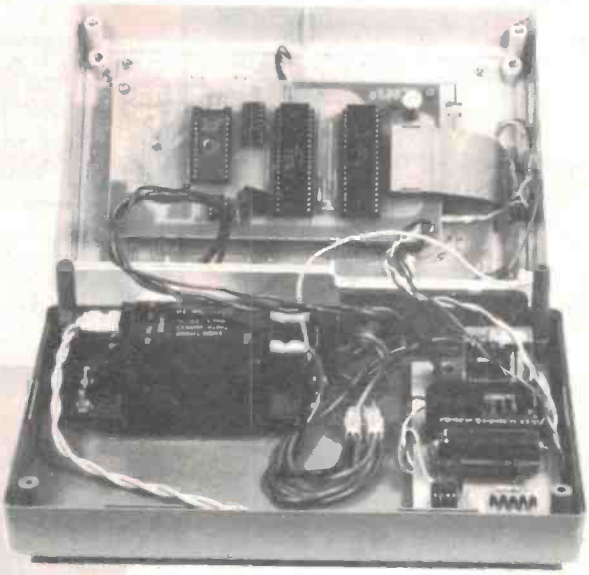
A darkroom exposure/process timer using a microprocessor controller

Peter Ihnat



Well, there you are in the darkroom; lights off; photographic paper on the enlarger's baseboard; you switch the enlarger on; you time the exposure with your watch . . . . OH NO! — what a time for the batteries to go flat; another wasted print. What you need is an exposure timer like the ETI-662d. Not only does it control your enlarger but it also functions as a process timer — that is, it is two timers in one.

THERE ARE TWO principal uses for timers in the darkroom — for controlling the exposure time when producing prints and for timing the length of processing steps when developing negatives, slides or prints.

A darkroom timer has the important function of controlling the length of exposure when producing prints with an enlarger. Generally, it consists of some sort of timing mechanism, which may be either mechanical (old) or electronic (modern), which switches a relay ON for the required length of time — the relay applying power to either a mains step-down transformer (which powers a quartz halogen lamp in the enlarger) or directly to the enlarger lamp (240 volt), depending on the type of enlarger being used.

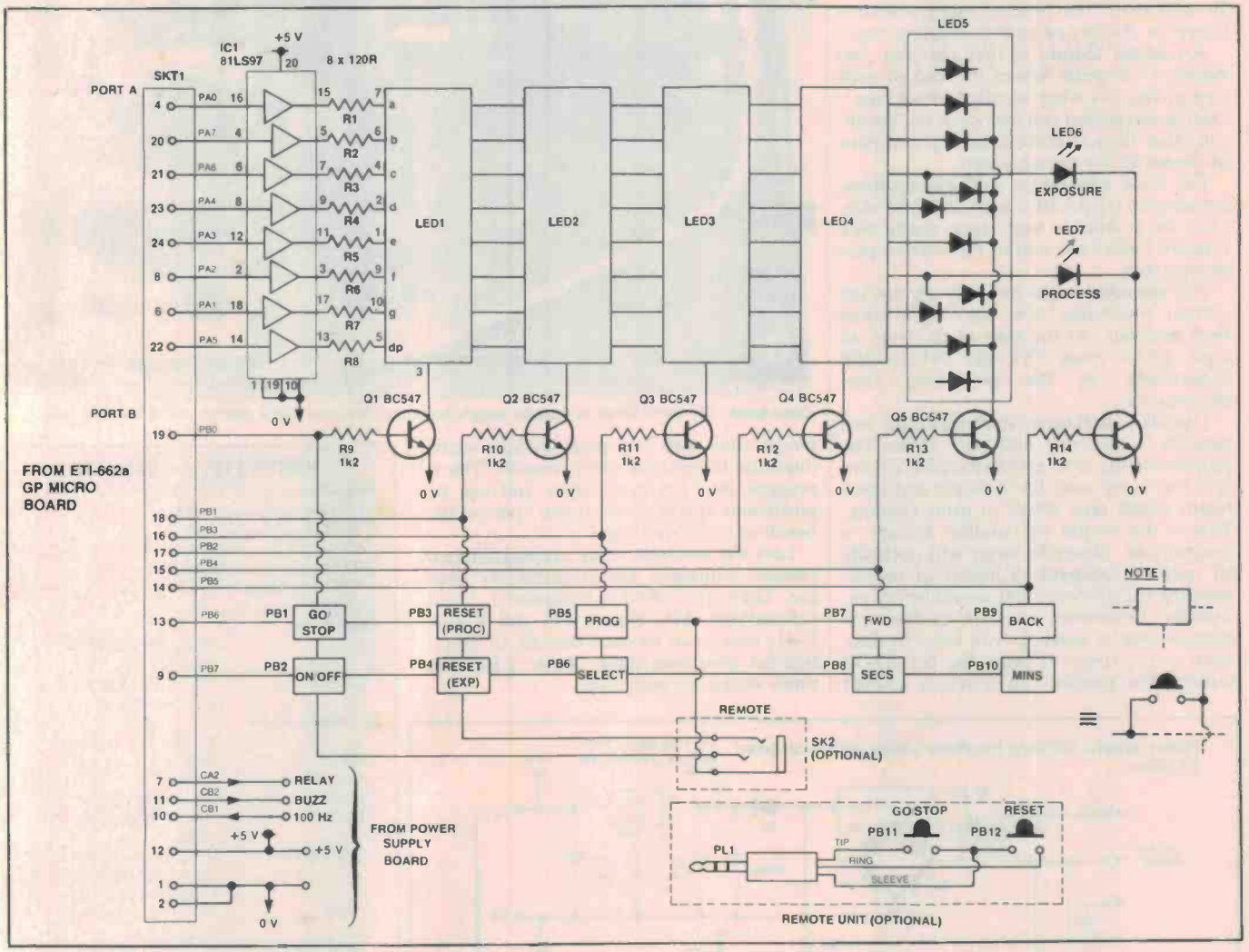
Exposure times can vary from several seconds to minutes, depending on the type of material being exposed. For example, colour prints from slides may require a 20 second exposure whereas a 508 x 610 mm (20" x 24") black and white print may need a few minutes. Larger prints may need exposure times in excess of 20 minutes. This requires that the timer be adjustable over quite a wide range. Thus, this project has been designed to allow exposure times up to 99 mins, 59 secs in intervals of one second. It allows times to be entered in minutes and seconds, which saves you from having to convert everything into seconds.

Most commercial timers allow only one time to be set and this is quite adequate for most people. But there are times when a number of different exposures are required to produce the one print. This can occur when techniques such as "dodging" or "burning-in" are used. More advanced techniques involve using masks to combine parts of several negatives or slides to produce the one print.

This project allows you to enter up to five exposure times and, each time the ON/OFF button is pressed, the next entry determines the current exposure time. For example, if you want to print a number of prints which require a normal exposure of 10 seconds, an area to be dodged for five seconds and another for seven, 10, 5 and 7 are simply entered as the exposure times. When ON/OFF is pressed, the enlarger will switch on for 10 seconds. The next press will switch it on for five seconds so that you can shade the appropriate areas. The next press gives a seven second exposure and the timer then resets so you can repeat the sequence.

Process timer

This device is used to indicate the end of a processing step when developing films or prints. Many photographers simply use a clock or their watches to time any processing, and this is quite adequate for simple processes such as for black and white prints. However, those who venture onto colour soon realise that some other form of timing would be more appropriate. There are colour processes which require many steps.



For example, Ektachrome slide film is processed using Process E-6 which involves 10 steps and takes just on 30 minutes from start to finish. Obviously, a simple clock is no longer adequate for timing each processing step since you need to keep looking up the time necessary for each step, unless of course you have a good memory. Wouldn't it be easier to have all the times entered in a timer which keeps track of the steps and then sounds a buzzer at the end of each step?

Well, all this is taken care of by this project. It employs the ETI-662a General Purpose or Minimum Micro System described previously, plus a display board and a power supply/relay board.

Features

This darkroom timer is basically two timers in one. They operate independently of each other but run simultaneously. The exposure timer in the unit allows up to five exposure times to be programmed. The process timer allows up to ten processing steps to be programmed. This allows the unit to be used for many of the common colour processes.

HOW IT WORKS — ETI 662d

The operation of the Darkroom Timer is very similar to that of the ETI-662b Timer/Controller described earlier. Three boards are used — the General Purpose Microprocessor (ETI-662a), a display board (ETI-662d) and a power supply board (ETI-662e).

The intelligent part of the Timer is the microprocessor board which has two programmable 8-bit ports (programmable in the sense that each bit can be set up to be either an input or an output line). Port A is configured as an output port and feeds the anodes of all the LEDs in the 7-segment displays. IC1 buffers the port to provide more drive to the displays. The other port, Port B, is set up as six output lines (PB0-PB5 pins 14-19) , and two input lines (PB6 and PB7, pins 13 and 9). These 'enable' the displays and pushbuttons individually by a technique called multiplexing. This involves placing segment data on Port A for display 1 and putting a high (1) on PB0 to turn on Q1. Then, segment data for display 2 is output and Q2 switched on, etc. If this is repeated several hundred times per second, the displays appear to be on continuously.

The pushbuttons are scanned in a similar manner, except that each of the lines PB0 and PB5 goes low (0) in turn. If no button is pressed, PB6 and PB7 sit high (1). If a button is pressed, the combination of bits input and output produces a unique code for each pushbutton. For example, if the GO/STOP button is pressed, then 10111110 will be read (by the microprocessor) on Port B, since the low output on PB0 is connected to PB6 via the depressed button. Note that the remote unit (optional) simply connects to lines PB0, PB1 and PB6 and duplicates the GO/STOP and RESET(PROC) buttons.

The power supply is a standard design and produces +5 V from IC2. Diode D5 isolates the bridge rectifier from the filter capacitor (C1) so that a 100 Hz signal can be fed to IC3, a 7555 timer connected as a Schmitt trigger here. Resistors R15 and R16 simply reduce the voltage and C4 filters any hash which enters from the mains. The output from IC3 is a clean 100 Hz signal which is further divided under software control to 1 Hz and provides the basic timing for the device.

Lines CA2 and CB2 are outputs from the microprocessor and control the relay (via Q7/Q8) and the buzzer (via Q9). More details of the programming will be given in the next instalment.

In operation, the process timer sounds a buzzer at the end of each processing step.

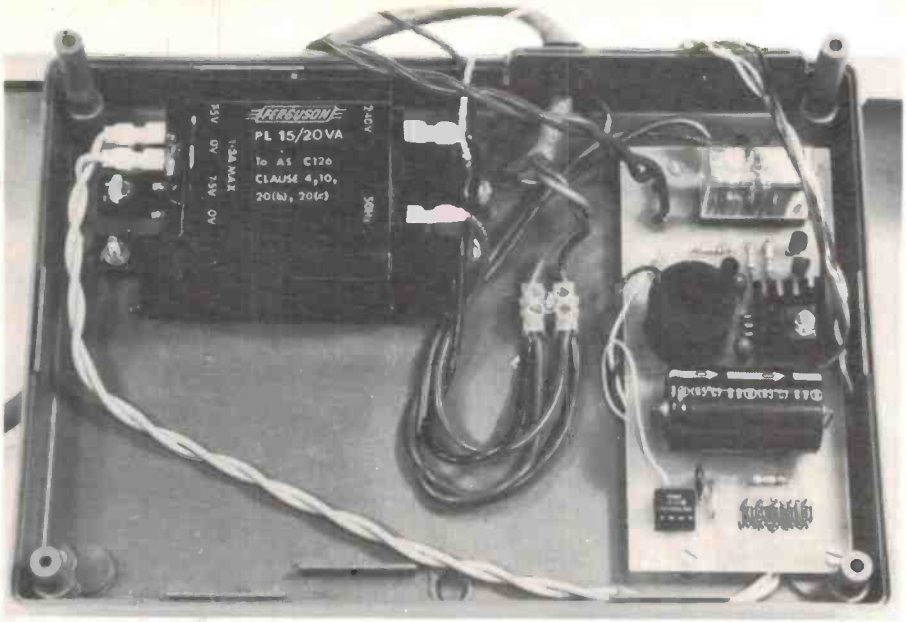
An added feature is that the unit also buzzes 15 seconds before the end of each step giving you what is called 'drain time'. During this period you may pour out chemicals from the last processing step and pour in chemicals for the next step.

For those who prefer analogue displays, an array of eight LEDs is provided to indicate, in a relative way, how much time remains before the end of the current processing step.

The microprocessor basically divides the current processing time into eight equal time intervals. At the start of the step, all eight LEDs come ON and switch OFF sequentially as the processing time decrements.

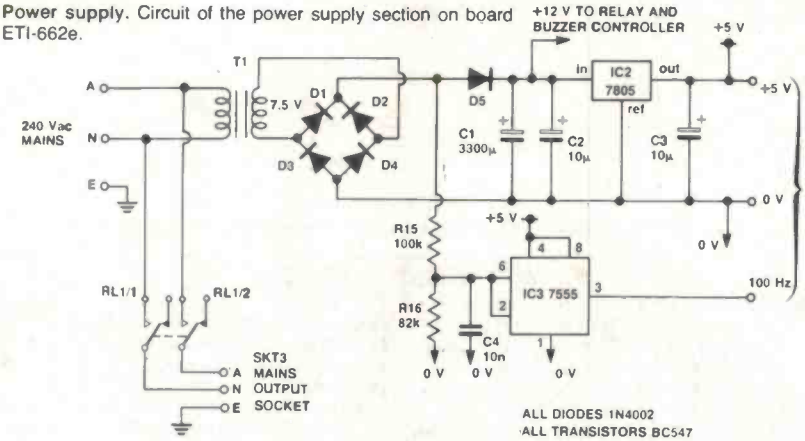
Usually a darkroom is divided into two sections — the 'dry' and 'wet' areas. The purpose of this is to avoid splashing chemicals and water onto the enlarger and baseboard which may result in print staining. This is the reason for another feature, a remote unit. Since the timer will normally sit near the enlarger, a means of recommencing the process timer would be advantageous. Otherwise, as soon as the next process step is entered, you have to dash over to the timer to press the GO/STOP button. The remote unit is simply a small plastic case with two push buttons which duplicate the process timer controls. This is plugged into the main timer and can be positioned in some convenient spot on the bench in your 'wet' area.

Last but not least, four preprogrammed process sequences are available for your use. They are — Kodak Ektaprint 2, Ilford Cibachrome AII, Kodak E-6 and Kodak C-41, which can be used directly or modified for your own setup. Table 1 lists the times stored for each step.

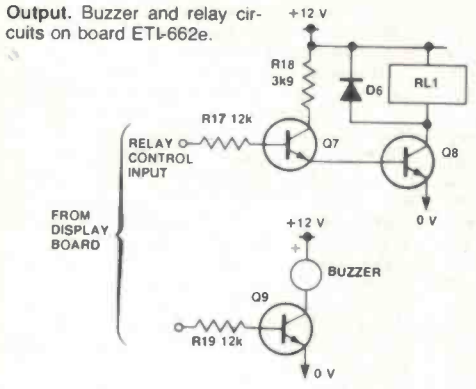


Case base. The transformer and power supply board are mounted in the bottom half of the OKI case.

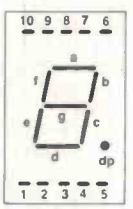
Power supply. Circuit of the power supply section on board ETI-662e.



Output. Buzzer and relay circuits on board ETI-662e.



LED DISPLAY PINOUT



pin
1 segment e
2 segment d
3 common cathode
4 segment c
5 decimal point (dp)
6 segment b
7 segment a
8 common cathode
9 segment f
10 segment g

PARTS LIST — ETI 662d

Resistors ..... all ¼W, 5%
- R1-R8 ..... 120R
- R9-R14 ..... 1k2
- R15 ..... 100k
- R16 ..... 82k
- R18 ..... 3k9
- R17, R19 ..... 12k

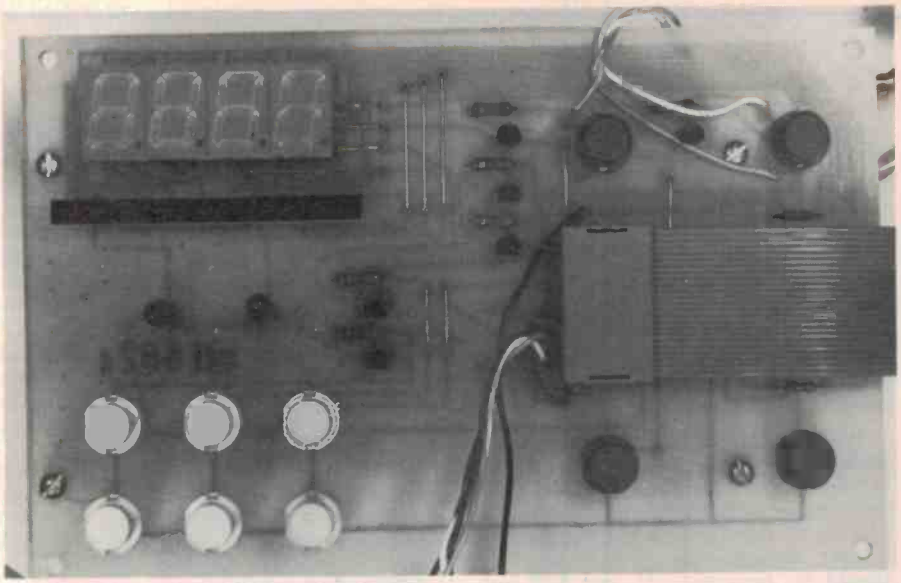
Capacitors
- C1 ..... 3300µ/25 V axial lead electro.
- C2, C3 ..... 10µ/35 V tag tant.
- C4 ..... 10n greencap

Semiconductors
- IC1 ..... 81LS97
- IC2 7805
- IC3 7555
- Q1-Q9 ..... BC547/8/9 etc
- D1-D6 ..... 1N4002 or similar, 1 A diode
- LED1-LED4 ..... HDSP-5303, HDSP-5503, Stanley NKR163 or similar 7-segment LED display.
- LED5 ..... 10-LED array (Altronics Z 0180)
- LED6, LED7 ..... TIL220R, 5 mm red LED

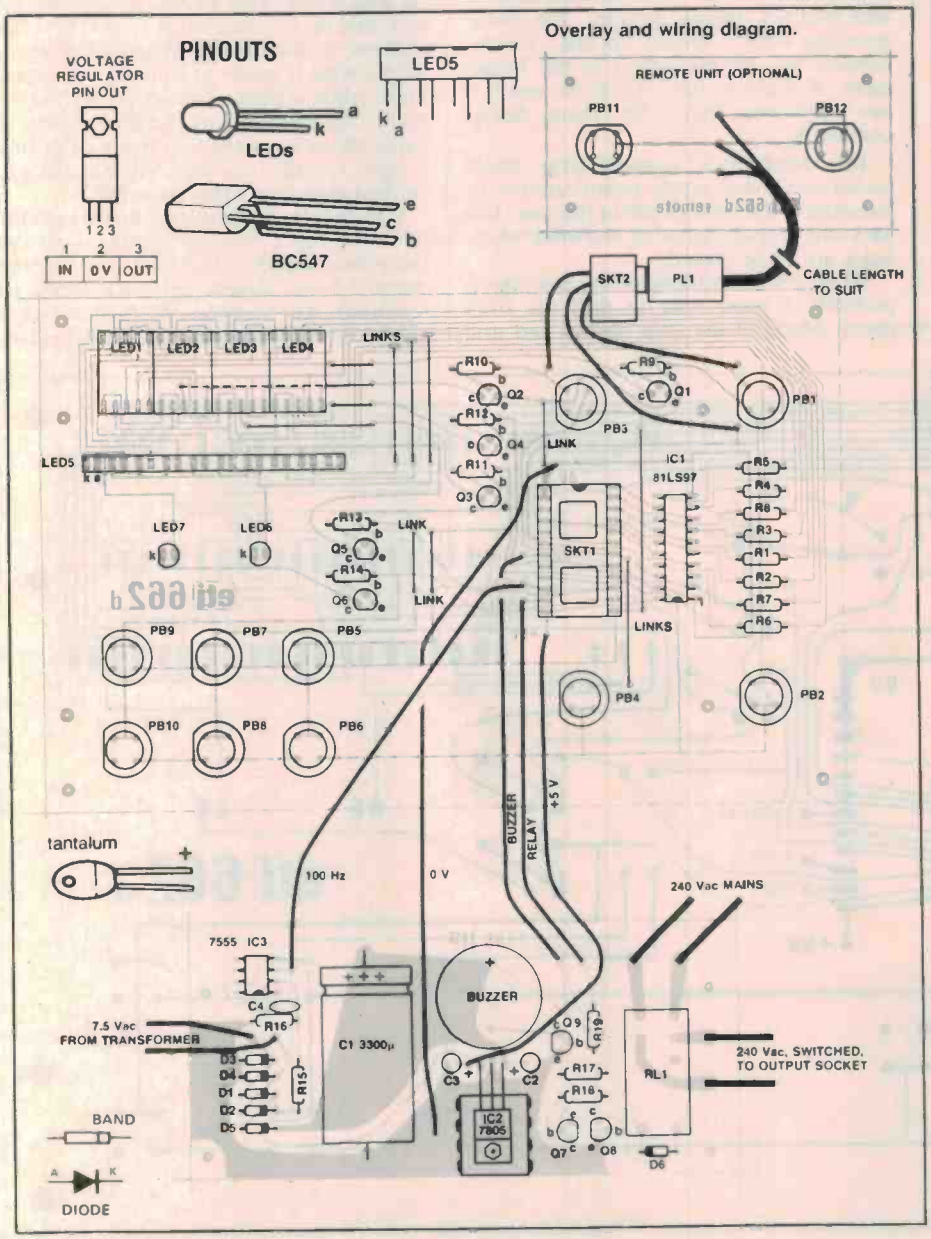
Miscellaneous
- T1 ..... PL15/20 VA Ferguson transformer or similar (2 x 7.5 V/1 A secondaries)
- RL1 ..... DPDT relay, pc mount, 12 V coil (eg: D.S.E. S-7130).
- PB1-PB10 ..... pc mount key switches
- PB11, PB12 ..... " " (optional)
- SKT1 ..... 24-pin DIL socket.
- SKT2 ..... stereo 3.5 mm jack socket.
- SKT3 ..... mains panel-mount socket.
- PL1 ..... stereo 3.5 mm jack plug (optional).

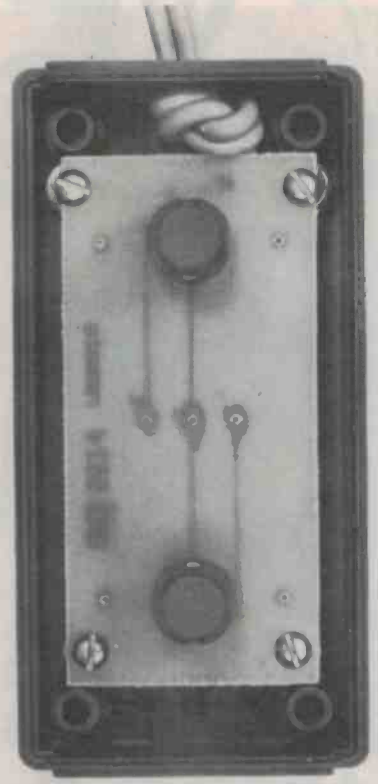
ETI-662d and ETI-662e pc boards; ETI-662d-remote pc board (optional); ETI-662a general purpose microprocessor kit (with 2732 EPROM containing darkroom timer program — battery backup components and 6116 RAM not required); plastic case — OKI type 90 80 087, from Mayer Krieg; optional small plastic case for remote — OKI type 90 10 087; Scotchcal front panel labels for main and remote (optional) units); piece of red filter material 60x40 mm; TO-220 heatsink (Thermalloy types 6030B, 6073B or similar); 20-pin IC socket; 8-pin IC socket; 24-core ribbon cable 150 mm long; two 24-pin IDC DIL plugs; figure-8 shielded cable for remote unit (optional — length to suit); two-way terminal strip; mains cable and three-pin plug; clamp grommet for mains cable; spacers, bolts, nuts, solder lugs, etc.

Price estimate: $160-$170



Display. The completed ETI-662d display board.





Remote. The remote unit is housed in a small OKI case. I wired the cable to the copper side of the board, for the sake of convenience. The cable should be knotted where it passes through the case to obviate any strain on the soldered connections. Use the bare pc board as a template to mark drilling holes for the two pushbuttons.

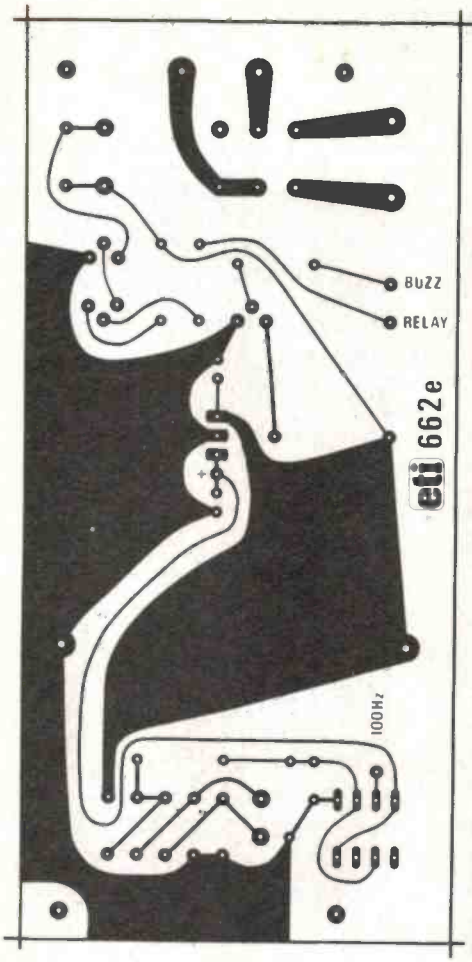
I housed the project in an 'OKI' make plastic case, No. 90 80 087 obtained from Mayer Krieg in Sydney. This has a convenient sloping front panel and plenty of internal room. For the remote unit, I used a small OKI case, No. 90 10 087.

Construction

The project comprises three pc boards:
ETI-662a GP microprocessor,
ETI-662d display board
ETI-662e power supply board.

The first of these was described last month and is the 'controller' behind this project (it does all the hard work). This board should be assembled first. Constructional details can be found in the relevant article. Note that the battery back-up components and the 6116 RAM IC are NOT required for the current project.

The display and power supply boards can be assembled next. Start with the wire links, resistors, capacitors, IC sockets and finally the larger components like filter capacitor, relay, 7-segment displays, etc. Care should be taken at all times during construction ▶



and this will almost certainly guarantee the device working first time (that sometimes elusive property of electronic projects!). Check the orientation of all components before inserting and soldering.

WARNING — the power supply board carries full mains potential around the relay contacts. Keep all low voltage wiring and your fingers away from this area. As a precaution, leave the mains wiring to the relay until the very end so that each board can be safely tested.

When the power supply board has been assembled, it can be tested as follows. Firstly, connect the transformer to the board and apply power to it. Switch off immediately if you see or smell smoke and recheck your circuit. Measure the 5 V output. This should be between 4.75 and 5.25 volts. Next, connect the 5 V line to the BUZZER and RELAY inputs in turn. The corresponding device should operate. Finally, connect the 100 Hz output to the buzzer input. A warbling tone should be heard. If any problems exist, fix them before continuing.

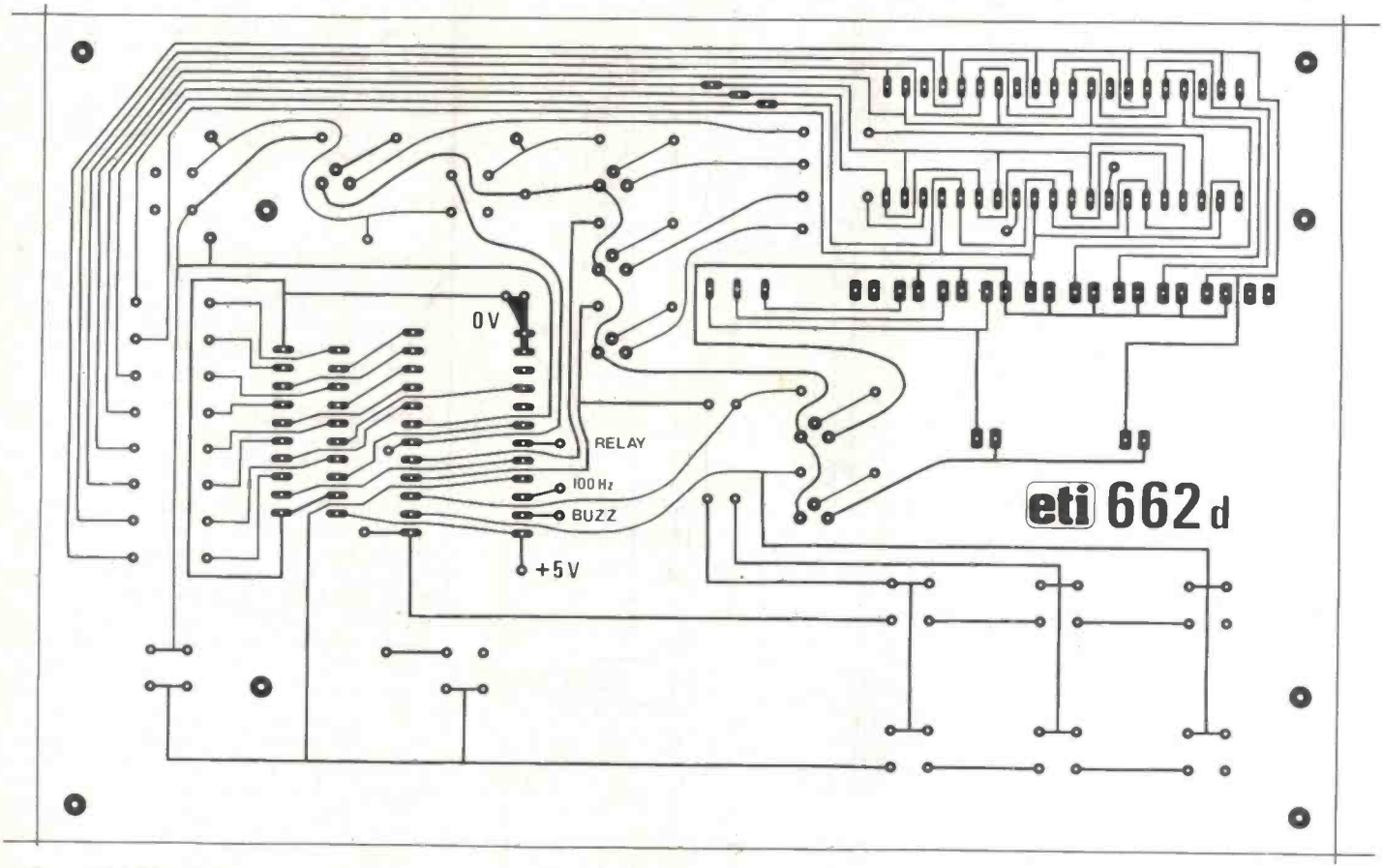
The transformer, terminal strip, mains socket and power supply board can now be mounted in the bottom half of the case. Use each as a template to locate and mark where holes are to be drilled.

While you are working on the case, this is probably a good time to drill the front panel. Mark all the hole centres and drill the appropriate size holes. A nibbler is sufficient to cut out the rectangular area for the displays. The display board sits behind the front panel on 9 mm spacers. Actually, I found that a nut between the board and spacer places it at the correct distance from the panel and also stops the spacers from falling off any time you may want to remove the pc board. This is shown in Figure 1.

The Scotchcal front panel artwork can now be applied. Note that, to eliminate a lump in the Scotchcal from the heads of the mounting bolts, I countersunk them and filled the dimple with Araldite.

A couple of tips when applying Scotchcal labels. Firstly, spray the front panel with white paint as this will stop any scratches and imperfections from showing through the thin material. Secondly, wet both the front panel and the tacky side of the Scotchcal with water. This allows the label to slip and slide on the aluminium so that you can position it accurately. When positioned, simply wipe it gently to squeeze out excess water while it dries. This may seem rather fiddly but sticking dry Scotchcal onto a panel allows you only one chance of getting it right. Usually, you miss. At least the wet method gives you room for error.

Connections to the display board can now be made. Eight leads are needed — five to the power supply board and three to the stereo 3.5 mm remote unit jack socket (if required). The connections to this socket need not be as shown in the circuit diagram



as long as you connect the remote unit's two buttons to the jack plug to match your connections to the socket.

All that remains is to connect the microprocessor board and to fit the display board behind the front panel. If you have not done so, plug the EPROM containing the drive software into the socket nearest the 6802 on the microprocessor board. Remember to check orientation. Then mount the microprocessor and display boards back to back using four 10-15 mm tapped spacers. Fit a 24-pin IDC plug onto each end of a 150 mm length of ribbon cable. Then plug one end into the I/O socket on the microprocessor board and the other into the socket on the display board. ●

. . . to be continued

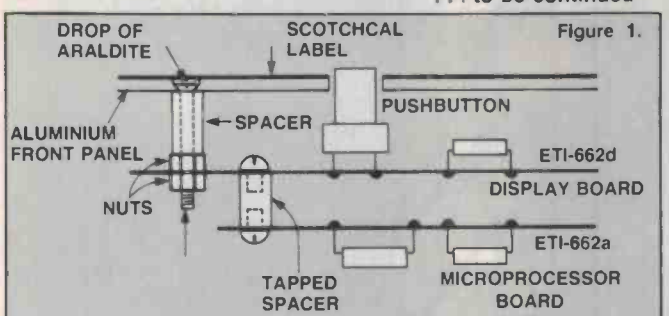
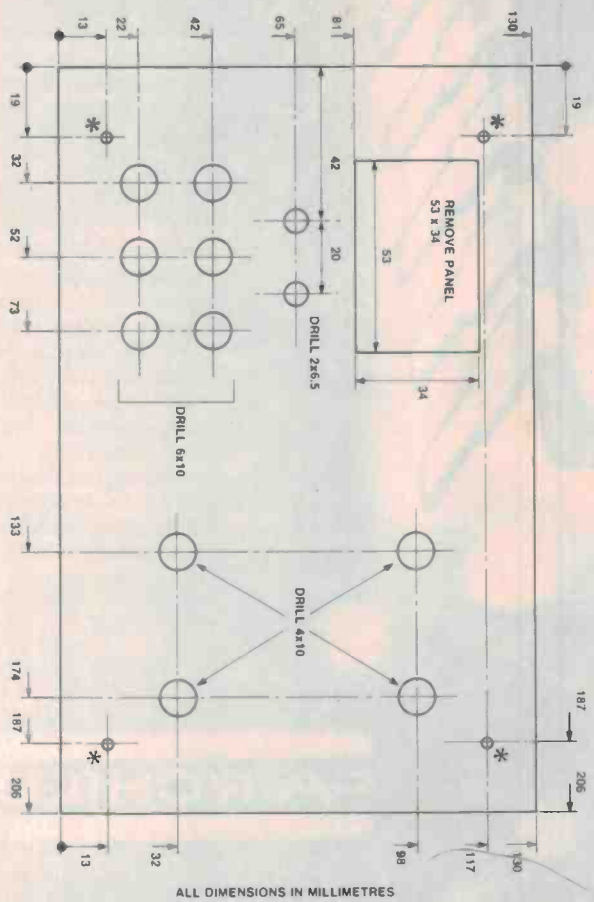


Figure 1.

Board assembly. Showing how the microprocessor and display boards are assembled to the front panel of the case.

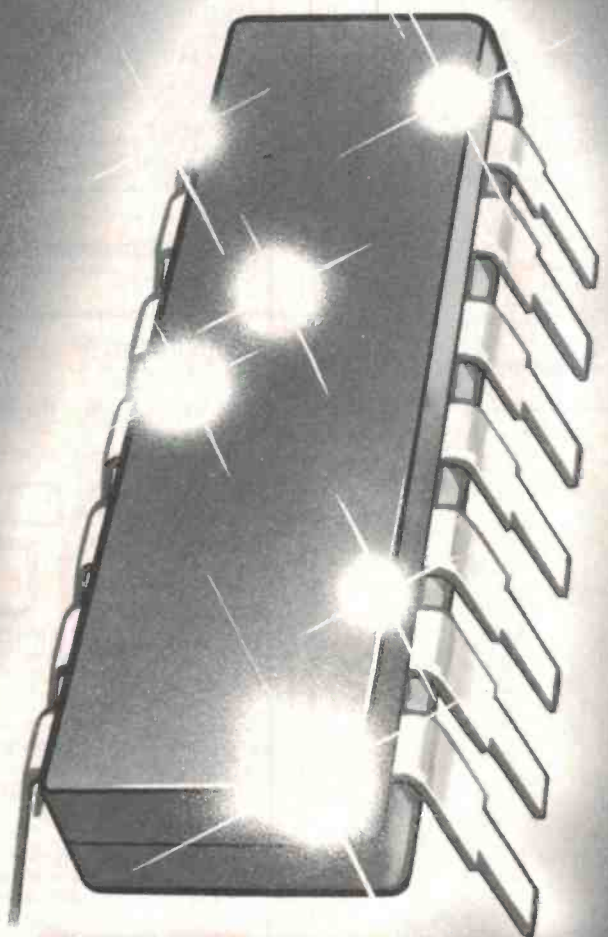


MICROPROCESSORS

The F6800 is a monolithic 8-bit microprocessing unit, forming the central control functions for the Fairchild F6800 family. The F6800 is capable of addressing 65K bytes of memory with its 16-bit address lines. The 8-bit data bus is bi-directional as well as 3-state, making direct memory addressing and multiprocessing applications realizable.

The F6850 Asynchronous Communications Interface Adapter provides the data formatting and control to interface serial asynchronous data communications information to bus-organized systems. The bus interface of the F6850 includes select, enable read/write, interrupt, and bus interface logic to allow data transfer over an 8-bit bi-directional data bus.

The F6847 Video Display Generator provides a means of interfacing the Fairchild F6800 micro-processor family to a commercially available color or black and white television receiver. Applications of the VDG include video games, bio-engineering displays, education, communications and any instance in which graphics are required.



The F6802 is a monolithic 8-bit microprocessor that contains all the registers and accumulator of the F6800, plus internal clock oscillator and driver on the same chip. The F6802 also has 128 bytes of RAM on board, located at hex addresses $0000 to $007F, Vcc standby can be utilized on the F6802 to facilitate memory retention during a power down situation.

The F6845 CRT Controller provides an interface between a MPU and a raster scan CRT device. The CRTC is used in the micro-processor-based controller systems for CRT terminals in stand-alone or multiterminal configurations, including smart programmable CRT terminals, video games, and information displays.

The F6821 Peripheral Interface Adapter provides a universal means of interfacing peripheral equipment to the F6800 MPU. This device is capable of interfacing the MPU to peripherals through two 8-bit bi-directional data buses and four control lines, in three speed ranges, 1.0MHz, 1.5MHz and 2.0MHz. No external logic is required for interfacing to most peripherals.

The F6809 8-bit microprocessor is an advanced, high performance member of the F6800 family. It offers greater throughput, improved byte efficiency, and increased adaptability to various software disciplines, including position-independent code, re-entrancy, recursion, block-structuring and high level language generation.

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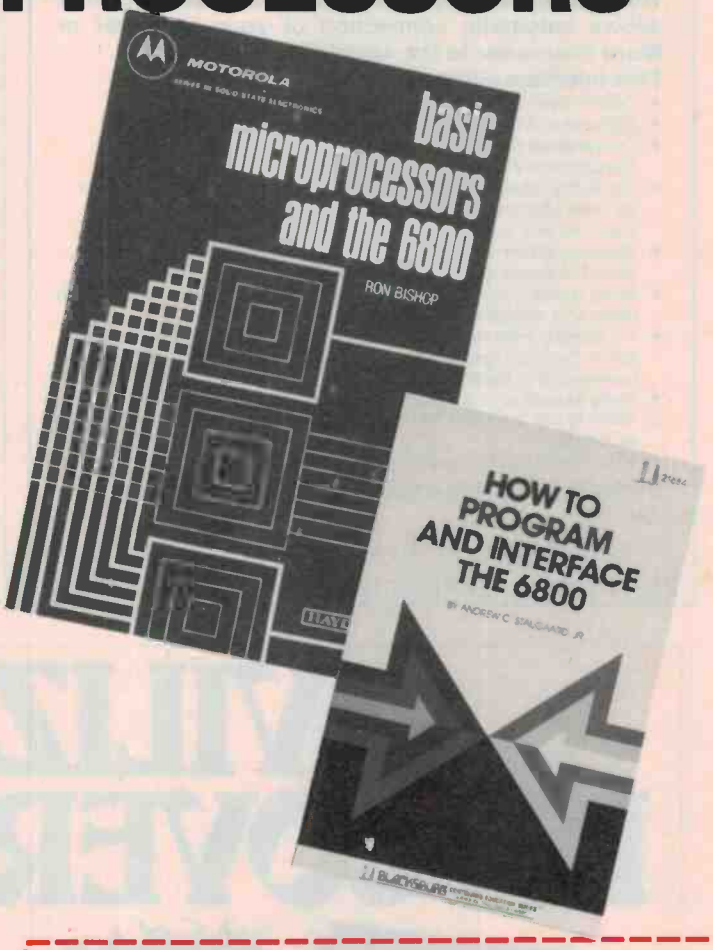

BOOK 1. Basic Microprocessors and the 6800

Written by Ron Bishop, Manager of the Motorola Semiconductor Group Technical Training division in the US, this is the "fundamental" text on the 6800. This book assumes nothing, save a high school science background. It starts right at basic electronic principles, goes on to explain logic elements, number systems, decimal, binary and hexadecimal), digital arithmetic, what are microcomputers, programming concepts, addressing modes, 6800 software, the 6800 micro family, system configuration, example programs and the M6800 instruction set summary. It's all there. Straight from "the prophet's" pen. All in 262 pages with a comprehensive index, measuring 152 x 228 mm. The US price on this book is US$14.95, which means it would normally sell here for around $25-$30.

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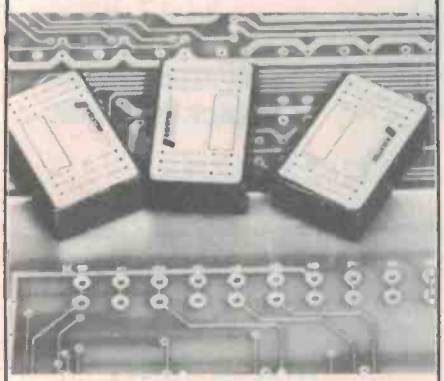

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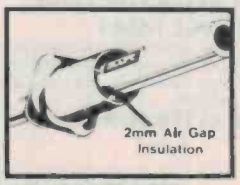

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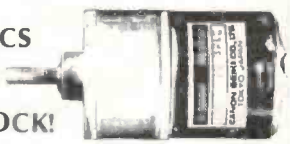

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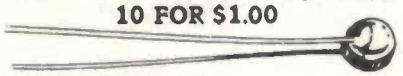

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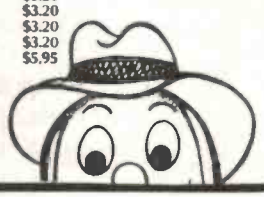

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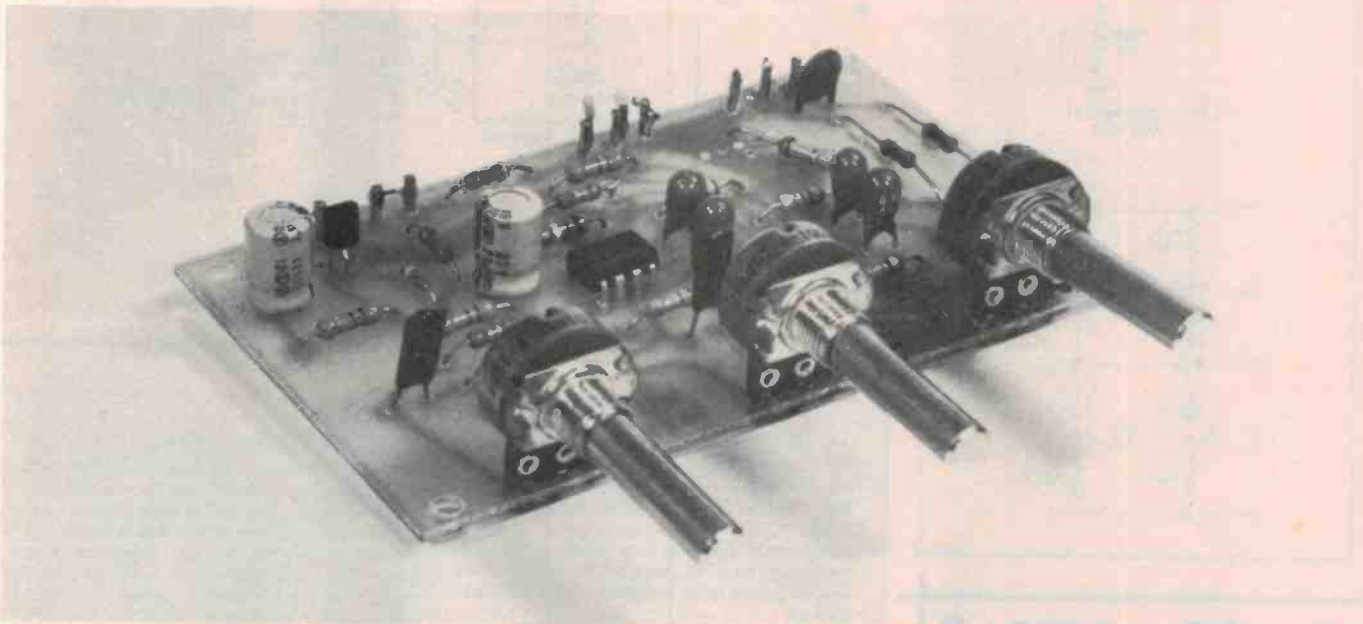
Versatile preamp module for a paging amplifier system

This project was designed as the preamp stage of a paging amplifier which will be described next month. We soon realised that the preamp itself was just what a number of readers had requested so it has been given a separate project number.



Geoff Nicholls

THE LAST balanced input preamp described in ETI was the ETI-461, published in December 1982. The '461 is a full instrumentation amplifier and has very good specifications suitable for virtually all balanced transducers. For most microphone work however, the simpler differential amplifier is generally adequate and is what I've chosen to use in this project. The ETI-461 article is recommended reading to clarify the pros and cons of each approach.

In this project I have provided a proper transformerless balanced input to allow professional, low impedance balanced mics to be used, with their inherent advantages of low hum and interference pickup. I have also provided bass and treble controls and a muting facility that allows push-to-talk dc switching without running the low level signal all over the place. This also allows many preamps to have their outputs summed without adding a lot of noise from unused inputs.

The unit is constructed on a pc board measuring just 60x100 mm. The level, bass and treble potentiometers are 17 mm diameter printed circuit mounting types that require a standard 9 mm mounting hole and have a standard 6.4 mm (¼") shaft. They are imported and distributed by Soanar. The board assembly may be mounted to a panel using the pots, although four holes around the board perimeter may be used as an alternative. 'Standard' pots may be used but the board will have to be mounted separately.

The differential input stage employs a single NE5534 with provision for either direct or capacitive coupling. the common-mode rejection ratio (CMRR) may be adjusted by means of an on-board trimpot or simply set by a resistor. A CMRR in excess of 115 dB may be achieved, but this is well in excess of the commom-mode noise commonly attained with balanced lines of around −60 dB. Hence, setting the CMRR with a fixed resistor beforehand will probably suffice in many circumstances.

A TL072/μA772 dual op-amp provides a buffer stage between the level control at the output of the 5534 and the tone control stage. The tone controls are not like the familiar 'hi'fi' controls. As this preamp is meant for voice work in a public address system, the bass breakpoint is set at 800 Hz and the treble breakpoint at 1200 Hz. The choices may seem surprising, but provide quite effective control. The boost and cut range is around +/−10 dB, which is adequate for the application.

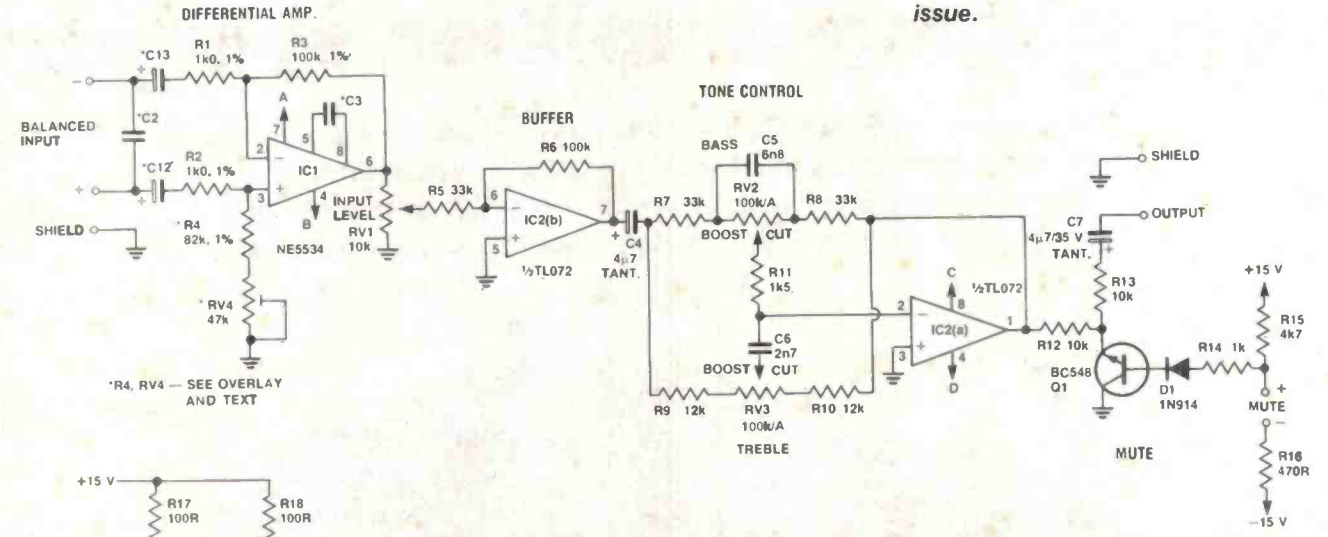
The mute circuit is adapted straight from David Tilbrook's Series 5000 preamp (why re-invent the wheel?).

The output of this unit may be fed to the high level input of an existing preamp, such as the ETI-498, or even straight into a power amp. The dual rail power supply requires can be from 9 to 15 Vdc, so many existing supply rails should suffice. If you need a dual power supply module, then the ETI-581 (June 1977 and *30 Audio Projects)* will do nicely.

Construction

As always, first give the pc board a thorough inpsection and correct any faults, such as incorrectly drilled or undrilled holes, track 'bridges' or breaks, etc. Start with the link near RV1 and then install all the resistors and pots. The recommended pots are pc mounting types and the board can be supported by them alone if required. The pads for RV4 (if used) have been laid out to allow all common trimpots to mount with ▶

*For a guide to buying components and kits see **SHOP AROUND** this issue.*



Circuit. The connection of C1 is explained on page 97.

HOW IT WORKS — ETI 1421

The preamp can be divided into four sections comprising the differential input amplifier IC1, the level control buffer IC2b, the tone stage IC2a and the mute circuit, which involves Q1. Each op-amp is decoupled from the supply by an RC network for both positive and negative rails comprising R17-R20 and C8-C11.

DIFFERENTIAL INPUT AMPLIFIER

The standard single op-amp differential amp circuit is used with provision for ac coupling capacitors C12 and C13. These capacitors are not necessary with normal balanced microphones but have been included on the pc board so that the project may be more versatile. A high capacitance low voltage electrolytic capacitor such as 47µ/6 V or similar should be alright, although the ac common-mode rejection and stage distortion will inevitably be degraded if the capacitors are used. Capacitor C2 terminates the input for high frequency signals and improves the stability of the stage.

The gain of the differential amp is set by the ratio of R3/R1 (provided R1=R2 and R3=R4) and is 100, or 40 dB for normal balanced microphones. Other gain values may be achieved by changing the resistors, but if a gain of less than three is used then capacitor C3 (22 pF) must be fitted to ensure stability.

The common-mode rejection can be optimised by fitting RV4 (use a 22k trimpot) and changing R4 to 92k, 1%. This will allow a common-mode rejection ratio of over 100 dB to be achieved, although in practice the balanced cable running to the input will limit the CMRR to about 60 dB. A 100 nF ceramic capacitor C1, (not shown on the circuit) should be mounted on the input socket between the cable shield and the chassis for electrostatic screening.

LEVEL CONTROL BUFFER

The differential amp output feeds the level control pot, RV1, which sets the overall gain of the preamp. The buffer stage IC1b, minimises loading of the pot and provides a low output impedance for the following tone stage. The buffer gain is set by R6/R5 and is about five for the circuit values specified. Capacitor C4 isolates any dc offset from the preceding stages before the bass control. Without ac coupling here, if the bass control were set on boost, any offset would be amplified as well, possibly driving the next stage into output saturation.

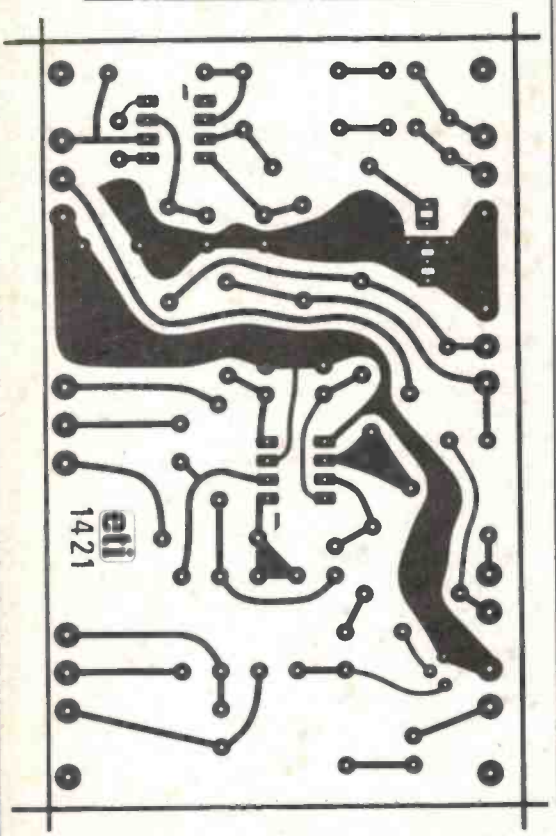
TONE CONTROL STAGE

This stage was designed using the National Audio Handbook (1977) 'Alternative Bass Design Active Tone Control' data which is detailed in Figure 2.14.16 in that book. The roll-off frequencies were chosen to suit voice signals and are lower than most designs, having breakpoints of approximately 800 Hz and 1200 Hz. The maximum boost and cut is about plus and minus 10 dB respectively, which is enough for microphone work.

MUTE CIRCUIT

This section is identical to the muting in the Series 5000 preamp as designed by David Tilbrook and described in ETI October 1981, page 36. Resistor R15 supplies base current to Q1 which clamps the junction of R12/R13 to 0 V to mute the preamp, unless the MUTE is disabled by a push-to-talk switch. A link across the MUTE terminals will allow signals to pass.

Several preamps can be connected to a summing amplifier (virtual earth) by simply connecting all outputs together. If the output is required to be dc-coupled then C7 may be deleted.



PARTS LIST — ETI 1421

NOTE: list for low-Z balanced mic input.

Resistors ..... all ½ or ¼ W 5% unless noted.
- R1, R2 ..... 1k0 1% metal film
- R3, R4 ..... 100k 1% metal film
- R5,7,8 ..... 33k
- R6 ..... 150k
- R9, R10 ..... 12k
- R11 ..... 1k5
- R12,13,15 ..... 4k7
- R14 ..... 1k
- R16 ..... 470R
- R17,18,19,20 ..... 100R
- RV1 ..... 10k/C pc mount pot . . . AUST C-10k T Z (see below)
- RV2, RV3 ..... 100k/A pc mount pot . . . AUST A-100k T X (see below)
- RV4 ..... 22k trimpot, optional (see text).

NOTE: The pc mount pots are from Soanar. Normal pots may be used, although the board will have to be mounted separately.

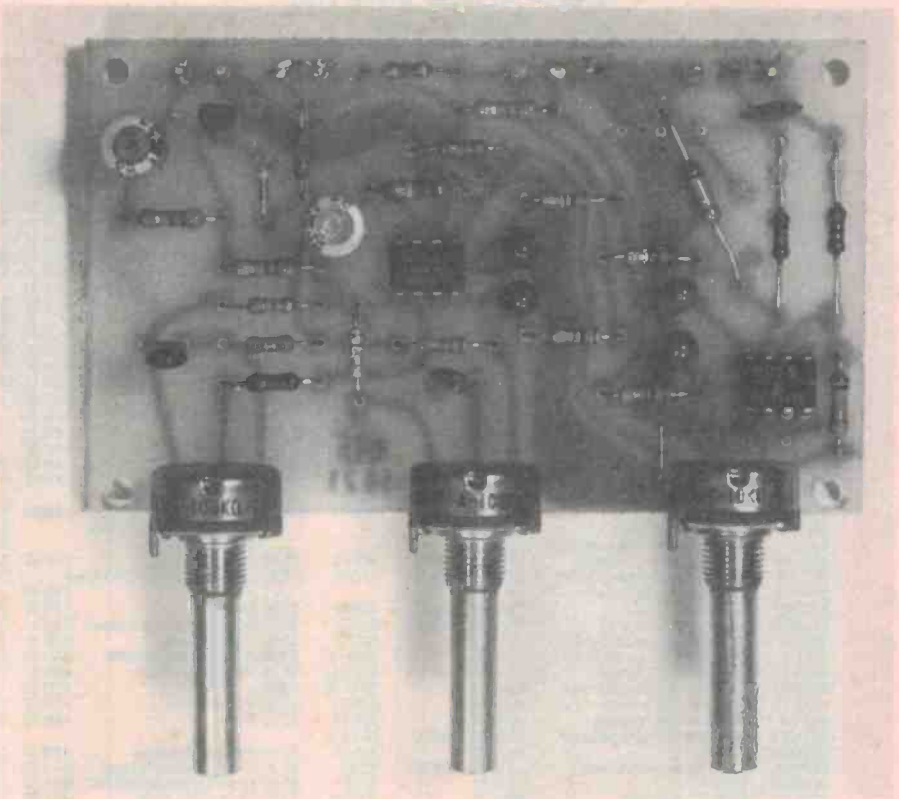
Capacitors
- C1 ..... 100n ceramic
- C2 ..... 4n7 ceramic
- C3 ..... 22p, see text
- C4,7,8,9,10,11 ..... 4µ7/35 V tag tantalum
- C5 ..... 6n8 polyester
- C6 ..... 2n7 polyester
- C12, C13 ..... 4µ7/6 V, see text

Semiconductors
- IC1 ..... NE5534A low noise op-amp
- IC2 ..... µA772, TL072 FET-input dual op-amp
- Q1 ..... BC548, BC108
- D1 ..... 1N914, 1N4148

Miscellaneous

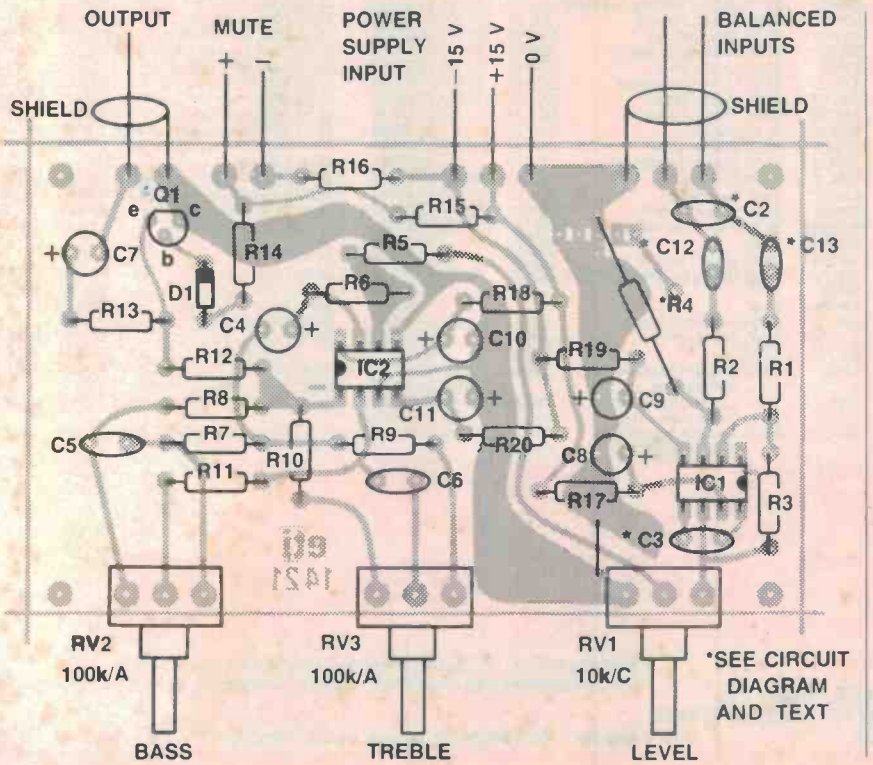
ETI-1421 printed circuit board; optional XLR 3-pin socket; hookup wire, pot knobs, pc pins, etc.

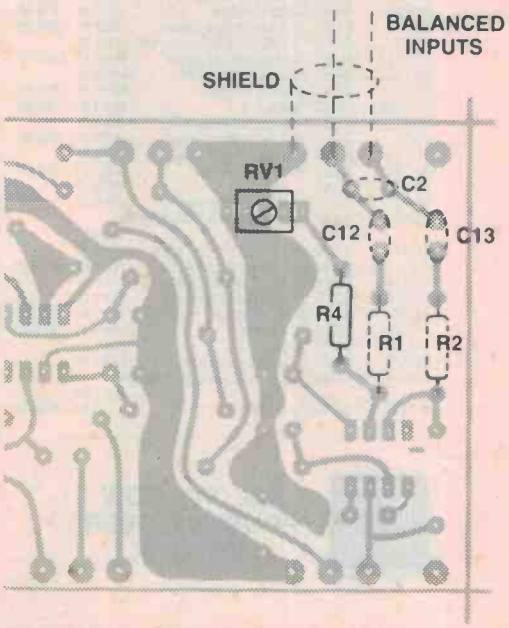
Price estimate: $18-$20



the screwdriver side towards the rear where it is accessible. The electrolytic capacitors are polarised and their orientation should be checked before soldering, as should the semiconductors. The two 8-pin IC sites on the pc board have pin 1 marked on the copper side to aid constructors. I used pc pins for the off-board connections.

If the project is to be used exclusively with low impedance balanced mics then ▶





CMRR trimmer. Alternative overlay showing the positions of RV1 and R4. With a normal vertically mounted miniature trimpot, the screwdriver adjustment slot should face away from the rotary post (towards rear of board). ▶

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		Hex keypad 19 keys		$39.50
75L11	$2.50			
78UP10	$9.50	2650 extra ram	OCT 78	
79FE11	$3.50	Photo flash exposure mtr.	NOV 79	$24.50
79PC9	$3.90	Pulse generator	SEP 79	
79SE3	$4.90	Train model sound	MAR 79	
79TI11	$3.90	Transistor assisted ign.	NOV 79	$34.50
79PS11	$2.90	Experimenters power sup.	NOV 79	
79PC12	$2.90	Fan speed control	DEC 79	
79SF10	$2.50	Photo slave flash	OCT 79	
79SF9	$2.90	Photo sound trigger	SEP 79	
79UPS6	$3.90	Universal power supply	JUN 79	$34.50
80ST10A	$3.90	Stylus timer	OCT 80	
80ST10B	$3.50		OCT 80	
80TC12	$3.90	Bipolar train controller	DEC 80	$34.50
80CM3A	$4.90	Digital capacitance mtr.	MAR 80	$49.50
80CM3B	$3.90		MAR 80	
80PG6	$7.90	TV pattern generator	JUN 80	$67.50
80TV8	$4.50	TV CRO adapter inc. p/pack	AUG 80	$39.90
80F3	$3.20	Audio prescaler	MAR 80	
80PP3	$2.50		MAR 80	
80LL7	$3.90	Leds & ladders	JUL 80	$19.50
80B7	$2.50	Beat frequency oscillator	JUL 80	
80BM10	$3.90	Car battery monitor	OCT 80	$11.50
80DC10	$6.50	Digital storage CRO ad.	NOV 80	$89.90
80HLA5	$2.90	Car headlight alarm	MAY 80	
80LS12	$3.50	Selectalott	DEC 80	$22.00
80LBR12	$2.90	Light beam relay	NOV 80	$13.00
80PC4	$2.90	Power heat controller	APR 80	
80PC7	$3.50	Power saver induc mtr	JUL 80	
80G6	$5.90	Musical tone gen.	JUN 80	
80GPS3	$2.90	Voltage regulator multi	MAR 80	
80AU3	$3.50	Hifi auto turn off	MAR 80	
80AW4	$4.50	Receiver all wave	APR 80	
80TM8A	$6.90	Digital engine analyser	AUG 80	$49.50
80TM8B	$2.90		AUG 80	
80PP7A	$8.50	Eprom programmer	JUL 80	$79.50
80PP7B	$3.90		JUL 80	
80RF5	$2.90	Rumble filter	MAY 80	
80SA3	$5.90	Playmaster stereo amp.	MAR 80	
80CH7	$8.50	240V ac light chaser	JUL 80	
80RAM12	$5.90	Ram expansion for dream	DEC 80	$39.00
80PA6	$7.50	Playmaster 300W amp module		$63.00
			JUN 80	
80CL4	$3.50	Timer controller	APR 80	
80TRS11	$2.90	TRS 80 printer serial in.	NOV 80	$17.50
80SA10	$9.90	Playmaster mosfet stereo amp.		
			JAN 81	
80AD12	$3.00	Autodim light dimmer	JAN 81	$32.00
80RM12	$3.90	Cylon voice simulator	JAN 81	$19.95
80FB12	$3.90	Guitar fuzz box	FEB 81	$19.90
81SW1	$3.90	Osc. switch dual trace	FEB 81	$60.00
81SP1	$2.90	TRS 80/SYS 80Serial interf.	FEB 81	
81GA3	$11.50	Color graphic analyser	MAR 81	$109.00
80GA12	$6.50	25W guitar amplifier	MAR 81	
81DC2	$3.50	Le Gong doorbell	MAR 81	$14.95
81DC3B	$8.50	Digital and	MAR 81	$189.00
81DC3A	$9.50	Analogue storage CRO	MAR 81	
81IR4	$4.50	Infra-red relay receiver	APR 81	$39.00
81RC4C	$2.90	Infra-red relay transmitter	APR 81	
81HB4A	$7.50	Heart rate monitor	APR 81	$82.00
81HB4B	$3.50		APR 81	
81MA4	$4.50	Touch sensitive alarm	APR 81	
81VM2	$2.90	High impedance DC voltmeter		
			APR 81	
81SI3	$7.90	TRS 80/SYS serial interf.	APR 81	
81RC4A	$4.90	2 channel (receiver)	MAY 81	$72.00
81RC4B	$2.50	Infra-red remote (preamp)	MAY 81	
81RC4C	$2.75	Control (transmitter)	MAY 81	
81SP5	$2.90	Sound pressure meter	MAY 81	$37.00
81CC5	$2.90	PC birdies	MAY 81	$14.50
81SS4	$4.90	Speed sentry	MAY 81	
81DT5	$3.00	Dream tape controller	MAY 81	
81MP6	$3.90	Microprocessor power supply		
			MAY 81	
81AO6	$4.90	Audio oscillator	JUN 81	$59.00

Board No	PCB Price	Description		Kit price
81UA6		Benchmate power supply	JUN 81	
81MC7	$2.90	Moving coil preamp	JUL 81	
81OR7	$9.50	Electrochume (electr. organ)	JUL 81	$59.00
81P6	$2.90	Pools/lotto selector	JUL 81	$22.50
81SW7	$4.90	Electronic steam whistle	JUL 81	$17.50
81MC8	$10.90	Musicolor IV	AUG 81	$84.00
81SM7	$3.90	Bagatelle	AUG 81	
81CL9	$4.00	Digital clock/thermometer	SEP 81	$80.00
81GA9	$4.90	Photon torpedo game	SEP 81	$24.50
81UC8	$4.50	Universal timer & stpwatch	SEP 81	
81WS10	$4.90	Wind universal indicator	OCT 81	$52.50
81AO10	$3.50	Audio test unit cass. deck	OCT 81	$47.50
81SS11	$8.90	Slide cross fader	NOV 81	$99.50
81SG9	$4.20	Led sandglass	NOV 81	$22.50
81AU11	$3.90	Audible turn indicator	NOV 81	
81FM10A	$5.90	500MHZ digital freq. mtr.	DEC 81	$135.00
81FM10B	$3.90		DEC 81	
81CH12	$3.50	Christmas decoration	DEC 81	
81LD12	$4.50	Led bar graph display	DEC 81	
81MI11	$3.90	Metronome (low current)	JAN 82	
81WD12A	$3.50	Wind direction indicator	JAN 82	$24.50
81WD12B	$3.50		JAN 82	
81P19	$6.90			
82EP1	$12.50	Free standing eprom prog with '24 pin' textool socket and AC plugpack	JAN 82	$45.00 $55.00 $69.50
82TH2	$3.90	Digital thermometer	FEB 82	$79.00
82CR1	$13.50	Lge. scrn. storage CRO Adapt	FEB 82	$119.00
82EG2	$3.90	Cudlip	FEB 82	$12.95
82PS2	$4.90	Dual tracking power supply	MAR 82	$87.50
82LF2	$3.90	Low fuel indicator	MAR 82	$16.50
82CM3	$3.90	LCD capacitance meter	MAR 82	$79.00
82AO3A	$7.90	Function generator	APR 82	$79.50
82AO3B	$3.90		APR 82	
82VC3	$3.50	Voice canceller	APR 82	$22.50
82VX4	$3.50	Vox	APR 82	$15.00
82VS10				
82PT4	$3.90	Photographic timer	APR 82	$48.00
82IV5	$5.40	12-240V inverter 40 watt	MAY 82	$49.50
82P5	$5.90	Universal preamp MM/MC	MAY 82	$35.00
82TO5	$3.90	Tacho/dwell meter	MAY 82	$72.50
82TS3	$3.90	Low cost touch switch	MAY 82	$12.00
82GA5	$9.90	Guitar booster	JUN 82	$17.50
82EM6A	$4.90	Theremin	JUN 82	$34.50
82EM6B	$3.90			
82IV6	$8.90	12-240V inverter 300 watt	JUN 82	$195.00
		Power monitor	JUL 82	$18.00
82HB6	$3.90	LDC heart rate monitor	JUL 82	$79.00
82CC7A	$15.50	Car computer	JUL 82	$109.00
82CC7B	$4.00	Car computer	to SEP 82	
82DP6	$4.90	Decimal point for D.G. meter	JUL 82	$70.00
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82FC8A	$6.50	Digital readout	OCT 82	$72.00
82FC8B	$3.90	For short wave	OCT 82	
82FC8C	$2.50	Receivers	OCT 82	
82TA10	$3.90	Freezer alarm	OCT 82	$21.00
82VS10	$7.90	Speech Synthesizer	OCT 82	
82PC10	$3.90	Power up	NOV 82	$36.00
82AL11	$3.90	Super siren	NOV 82	$23.50
82PC11	$3.90	Driveway sentry	DEC 82	$32.00
82QR12A	$9.95	Playmaster AM tuner	DEC 82	$239.00
82QR12B	$9.95		DEC 82	
82PH12	$4.90	Digital PH meter	DEC 82	$135.00
82EG12	$2.90	Boggle goggles (short form)	DEC 82	$9.60
82FD5	$4.90			
82DP6	$3.90			
83TV1A	$4.90	Remote infrared TV	JAN 83	$39.50
83TV1B	$2.90	Sound control	JAN 83	
83TV1C	$2.90		JAN 83	
83PS1	$3.90	Plugpack regulator with plugpack	JAN 83	$14.00 $29.50
83EG1	$3.50	Led head light chaser	JAN 83	$12.00
82WB1	$2.90	Wheatstone bridge	FEB 83	$45.00
82AO2	$2.90	AM tuner alignment kit	FEB 83	$8.00
		Moisture alarm	FEB 83	

Board No	PCB Price	Description		Kit price
79TI11	$3.90	Trans.ass. ignition updated	FEB 83	$34.50
83FC2		Fuel consumption meter	MAR 83	$50.00
83BP3	$3.90	Brown out protector	MAR 83	$25.00
83MS4	$3.90	Stereo simulator PCB version		$12.00
			APR 83	
		Self contained unit	AUG 83	$20.00
83PC3A	$3.90	Touch lamp dimmer	APR 83	$20.00
83PC3B	$3.50	Touch lamp timer	AUG 83	$21.00
83PS5	$4.90			
83SC7	$3.90	LCD event counter	JUL 83	$32.00
83SC8	$3.50	2MHZ digital freq. meter	AUG 83	$60.00
83VA8	$5.90	Video amplifier	AUG 83	$15.00
83EG5	$4.90	Electronic roulette wheel	MAY 83	$24.00
		Electronic breath tester	MAY 83	$25.00
83PS5	$5.90	50V/5A power supply	JUNE 83	$140.00
83GA6	$7.90	Effects unit	JUNE 83	$75.00
83PP5	$5.90	Overload indicator	JUNE 83	$20.00
83PS7	$3.50	± 12V for lab power supply	JULY 83	$13.00
83AL6	$2.90	Fridge door alarm	JULY 83	$9.00
83MS4	$3.90	Compumuse	AUG 83	$20.00
83WM8	$6.95	Electronic watt meter	SEPT 83	$65.00
83TT8	$3.95	Transistor tester	SEPT 83	$15.00
83MS8	$4.90	Soil heating unit	SEPT 83	$70.00
83VE10	$4.90	Video enhancer	OCT 83	$35.00
83MD9	$3.50	Nail finder	OCT 83	$10.00
83SS9	$3.90	Speed sentry	OCT 83	$11.00
ET014	$4.90	Dual voltage power supply	DEC 71	
ET043	$2.50	Heads or tails	OCT 76	$3.90
ET044	$2.50	Two tone doorbell	OCT 76	$4.90
ET047	$2.50	Morse practice set	DEC 76	$3.90
ET048	$2.50	Buzz boards	DEC 76	$4.50
ET061	$2.50	Simple audio amp	OCT 76	$5.90
ET062	$2.90	Simple AM tuner	MAR 77	$6.90
ET063	$2.90	Electronic bongos	NOV 79	$5.90
ET064	$2.50	Simple intercom	OCT 83	
ET065	$2.90	Electronic siren	DEC 79	$5.90
ET066	$2.50	Temp alarm	DEC 79	$5.50
ET067	$2.90	Singin moisture		$7.95
ET068	$2.90	Led dice	OCT 76	$6.90
ET071	$2.50	Tape noise limiter	JUN 79	
ET072	$2.50	Two octave organ	JUN 78	$9.50
ET081	$2.90	Tachometer	OCT 83	
ET083	$2.50	Train controller	DEC 79	
ET084	$2.90	Car alarm	JAN 77	$13.50
ET085	$2.50	Car over rev. alarm	OCT 79	
ET130	$2.50	Temp/volts converter	FEB 76	
ET132	$3.90	Experimenters power supply	FEB 77	
ET134	$2.90	R.M.S. voltmeter	AUG 77	
ET135	$3.50	Digital panel meter	OCT 77	
ET136	$2.90	Linear scale cap. meter	MAR 78	
ET137A	$4.90	Frequency meter LCD	MAY 78	
ET137B	$3.90	Audio oscillator	MAY 78	
ET139	$2.50	Power meter	MAY 78	
ET147	$4.90	Electronic dummy load	OCT 80	$99.00
ET149	$3.50	Two tone generator	JUL 80	$34.90
ET152	$2.90	Capacitance meter	FEB 80	
ET153	$3.50	Temperature adaptor	MAY 83	$19.95
ET157	$4.90	Crystal marker	OCT 81	$37.50
ET158	$3.50	Low Ohms meter	NOV 81	$36.50
ET159	$2.90	10-15V exp. scale voltmeter	DEC 81	$26.50
ET160		13.8V 10 amp power supply	JUL 82	
ET161	$4.90	Evaluation meter		
ET162	$4.50	0-30V var. power supply	DEC 82	$47.50
ET163	$6.50	0-40V/5A alb power supply	MAY 83	$169.00
ET164	$8.00	Zener diode tester	MAY 83	$9.00
ET166		Frequency counter	AUG 83	$16.00
ET166B	$4.90			
ET166C	$4.90			
ET166D	$4.90	Power supply	AUG 83	$24.00
ET165	$7.50	Tacho calibrator	NOV 82	$39.50
ET245	$2.90	White line follower	NOV 77	
ET255	$2.90	Thermometer	NOV 80	
ET256	$3.50	Humidity meter	OCT 83	$29.50
		Humidity sensor	OCT 83	$19.95
ET257	$2.90	Universal relay board	MAY 81	$13.50
ET258	$2.50	Mini drill speed controller	JUL 81	$9.50
ET259A	$3.90	Versatile 'incremental' timer	JAN 82	$39.00
ET259B	$3.90			
ET260	$2.60	Photo lamp flasher	DEC 79	

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ET263	$2.90	Simple egg timer	DEC 79	
ET264	$2.90	Simple siren	MAR 80	
ET265	$3.90	Power down	JUL 83	$37.00
ET268	$2.50	Nicad float charger	MAR 83	$9.50
ET316	$3.50	Transistor assisted ignition	MAY 77	$34.00
ET317	$3.90	Car rev monitor	JUL 77	
ET324	$4.90	Led tacho	AUG 80	$34.00
ET323	$3.90	Headlight delay	MAY 83	$17.50
ET325	$2.50	Car auto electric probe		
ET326	$2.50	Exp. scale led voltmeter	SEP 80	$12.50
ET327	$3.50	Turn/Hazard indicator	OCT 80	$22.00
ET328	$2.90	Led oil temp meter	JAN 81	$19.00
ET329	$2.50	Exp. scale vehicle ammeter	FEB 81	$19.00
ET330	$3.90	Car alarm	JUL 81	$29.00
ET332	$3.90	Electronic stethoscope	AUG 81	$34.00
ET333	$3.90	Reversing alarm	JAN 82	$10.00
ET334	$3.90	Auto tester	JAN 83	
ET335	$4.50	Windscreen wiper controller	MAR 83	
ET336	$3.90	Low cost tacho dwell	AUG 83	$24.00
ET363	$3.50			
ET417	$2.90	Overload indicator	AUG 73	
ET421		Three way (Dick Smith)	SEPT 83	
ET438	$3.90	Led level meter		$12.95
ET440	$8.50	25 Watt stereo amp	MAR 75	
ET445	$2.90	General purpose preamp	JUL 76	$8.25
ET446	$3.90	Stereo limiter	JUL 76	
ET449	$3.90	Mike preamp	MAY 77	
ET450A	$4.90	Bucket brigade	DEC 77	
ET450B	$4.90			
ET452		Guitar practice amplifier	JAN 80	
ET453	$2.90	Amp class B gen purpose	APR 80	
ET454	$3.90	Fuzz box	APR 80	
ET455	$4.50	Loud speaker protector	MAR 80	$32.50
ET457	$3.90	Scratch & rumble filter	SEP 80	$49.50
ET458	$4.90	Led level meter	JUN 81	$27.00
ET459A	$16.50	Series 5000 1/3 oct graph equ	NOV 82	$199.00
ET459B	$16.50	Graphic equ. front panel Graphic equ. metal work		
ET461	$3.90	Balanced input preamp	DEC 82	$20.00
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ET466	$8.50	300W amp module	FEB 80	$67.50
ET467	$6.90	4 input mike preamp	JUL 80	$29.50
ET470	$4.50	60 watt amp module series 4000	TPV 6	$26.00
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ET485	$5.25	Graphic equaliser	JUN 77	
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ET489B	$3.50			
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ET496	$8.90	Series 4000-1 speaker kit Speakers & crossovers Crossover kits Speaker boxes (prices per pair)	FEB 80	$779.00 $499.00 $199.00 $299.00
ET499	$4.95	50W mosfet amp 75-85 Transformer Anodised heatsink	MAR 82	$79.00 $43.50 $42.50
ET525	$4.90			
ET527	$5.90			
ET528	$2.90	Intruder alarm	JAN 75	
ET539	$3.90	Touch switch	MAR 76	
ET541	$3.90	Train controller	MAY 76	
ET547	$3.50	Telephone bell extension	JUN 77	
ET549A	$3.90	Metal detector	MAY 77	
ET560	$2.50	240V mains locator	MAY 80	
ET561	$3.90	Metal Detector	MAR 80	$34.00
ET562	$3.90	Geiger counter	APR 80	
ET563	$4.50	Nicad fast charger	JUL 80	$59.95
ET566A	$2.90	Pipe & cable locator	APR 80	
ET566B	$4.90			
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ET650B	$4.50			
ET650C	$4.50			
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EA 83PS12 VK Powermate
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EA 83KWH12 Energy monilor
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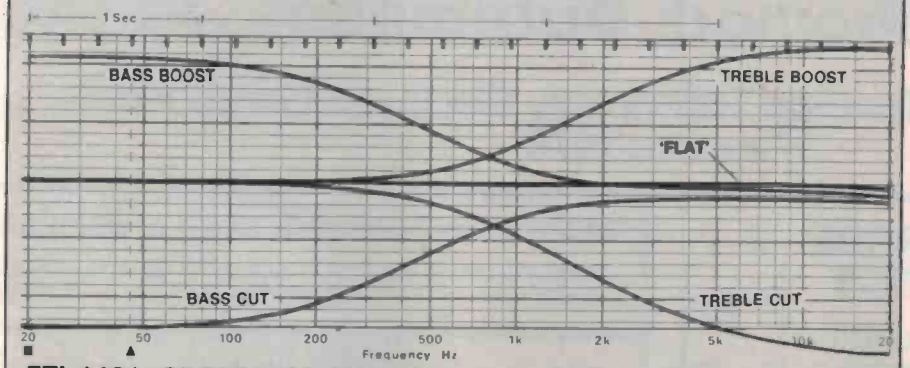


ETI-1421: SPECIFICATIONS OF PROTOTYPE

Supply rails +/−15 V

Overall Gain, input to output	54 dB
Output impedance	10k unmuted, 5k muted
Maximum output level	6 V RMS into 100k
Noise at output	400 μV RMS (unmuted);
— 470R between inputs	less than 3 μV (muted)
— level at max	
— tone controls centred	
— 20 kHz unweighted	
Equivalent input noise	800 nV RMS (unmuted)
N.B. Measurements with 400 Hz hum filter switched in on the N & D meter were ¼ dB lower	
CMRR (without trimpot)	better than 90 dB
(with trimpot)	better than 115 dB
Distortion at 1 V RMS, 1 kHz output	<0.03%
Bass control range	+/−10 dB at 100 Hz
Treble control range	+/−10 dB at 5 kHz
Frequency response (tone controls 'flat')	20 Hz to 20 kHz, +0/−0.5 dB

capacitors C12 and C13 can be left out and resistors R1 and R2 installed to bypass the extra pads. Similarly, if the mute function is not required then Q1, D1, R14, R15 and R16 may be deleted.

Check out

Basically, to check it out, all you need is a power supply and headphones. Set the level control at minimum and the tone control at centre rotation. If you've installed the common-mode adjustment trimpot, set it at halfway. Hookup a power supply (anything from +/−9 to +/−15 volts) and the headphones and link the MUTE terminals. Advancing the level control with the input open will increase the noise in the headphones. Touching one input pin should result in a loud burst of hum. Removing the link from the mute terminals should immediately cut the output.

If you have a mic and an amplifier on hand, hook it up and give it a try out.

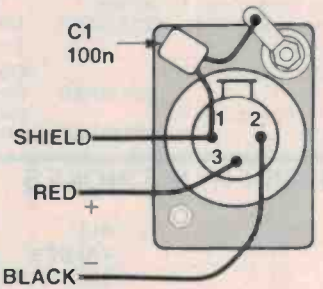
Common-mode adjustment

The common-mode rejection ratio (CMRR) is obtained by dividing the differential gain by the common-mode gain. This section is only for constructors who have opted to fit the common mode rejection trimpot RV4. If used, RV4 should be 22k and R4 should be 91k, 1%.

Set the level control to maximum and centre the tone controls. (i.e: 'flat' position). Connect the two balanced inputs together and apply a 1 kHz signal of about 10 Vp-p between then and the shield. Monitor the differential amplifier output at pin 6 of IC1 and adjust RV4 to minimize the common-mode gain. The prototype achieved a CMRR of 117 dB, but it was a fiddly adjustment.

Alternatively you may connect a balanced mic and listen to the preamp through a headphone amplifier while adjusting RV4 for minimum hum. ●

CANNON SOCKET
looking at solder lug side



Input wiring. Suggested input wiring. Pin 1 of the Cannon socket goes to the board common track, which **should not** be connected to the chassis. C1 ties the chassis to the common for ac signals, avoiding 'earth loops' via chassis connections.

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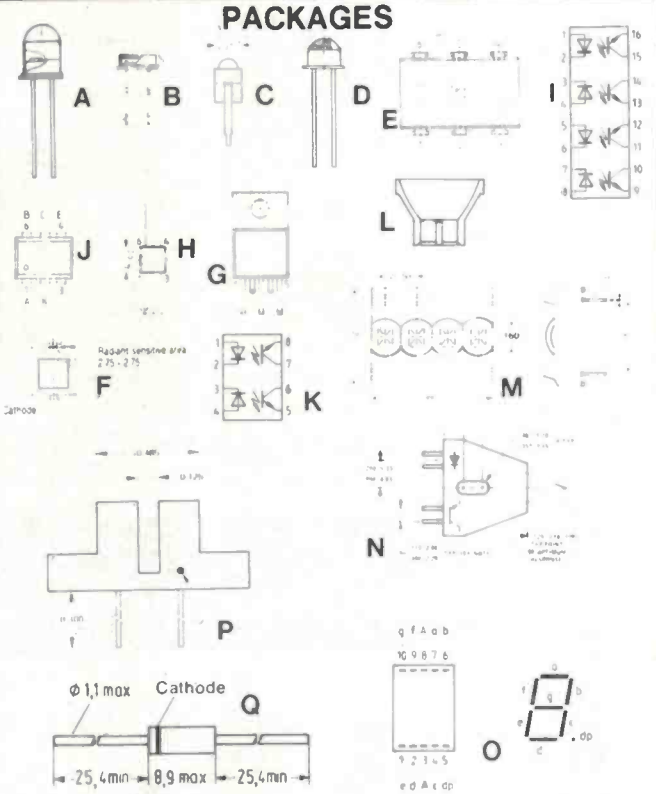
PACKAGES



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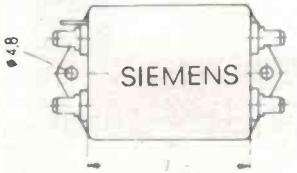

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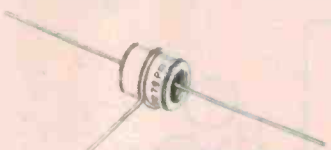
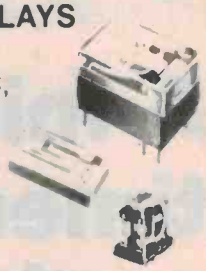


Telecom line lightning protector T61-350 (as seen on 60 Minutes) $8.00

SIEMENS MINIATURE PCB RELAYS 1 AND 2 CHANGE OVER



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A microprocessor-based timer/ controller

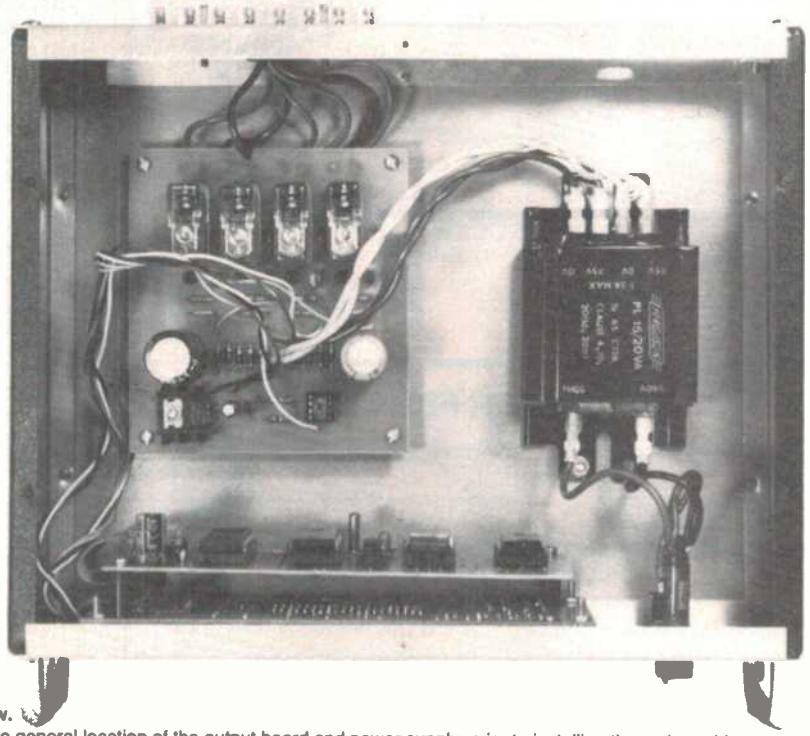
This part completes the construction and testing of the unit and gives details on programming and using it.

Peter Ihnat

HAVING GOT the project running on a temporary hookup, if all is well, it can be mounted into your chosen case. You can use any case of dimensions of at least 254 x 100 x 200 mm (L x H x D). I used a locally-made Horwood case, type 84/10/V. The construction of the front panel is quite tricky since it involves "drilling" square holes for the pushbuttons. Note that the specified pushbuttons are also available with a round top and could be used by the less adventurous. The display board mounts behind the front panel with 9 mm spacers. If countersunk bolts are used then it is possible to hide their heads beneath the Scotchcal label (especially if it's the aluminium stuff which is quite thick).

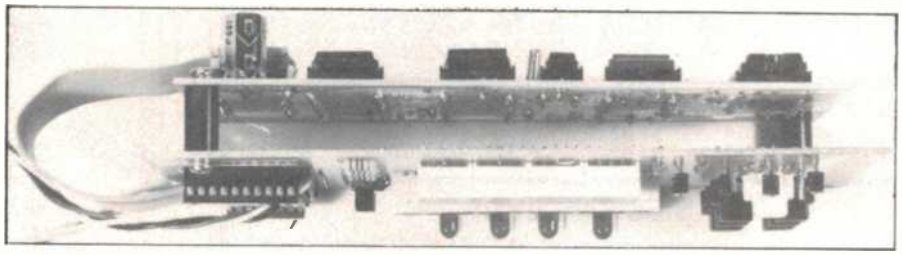
The transformer and power supply board are mounted as shown in the photograph. A terminal strip mounted on the back of the unit brings the relay contacts to the outside world and completes the unit.

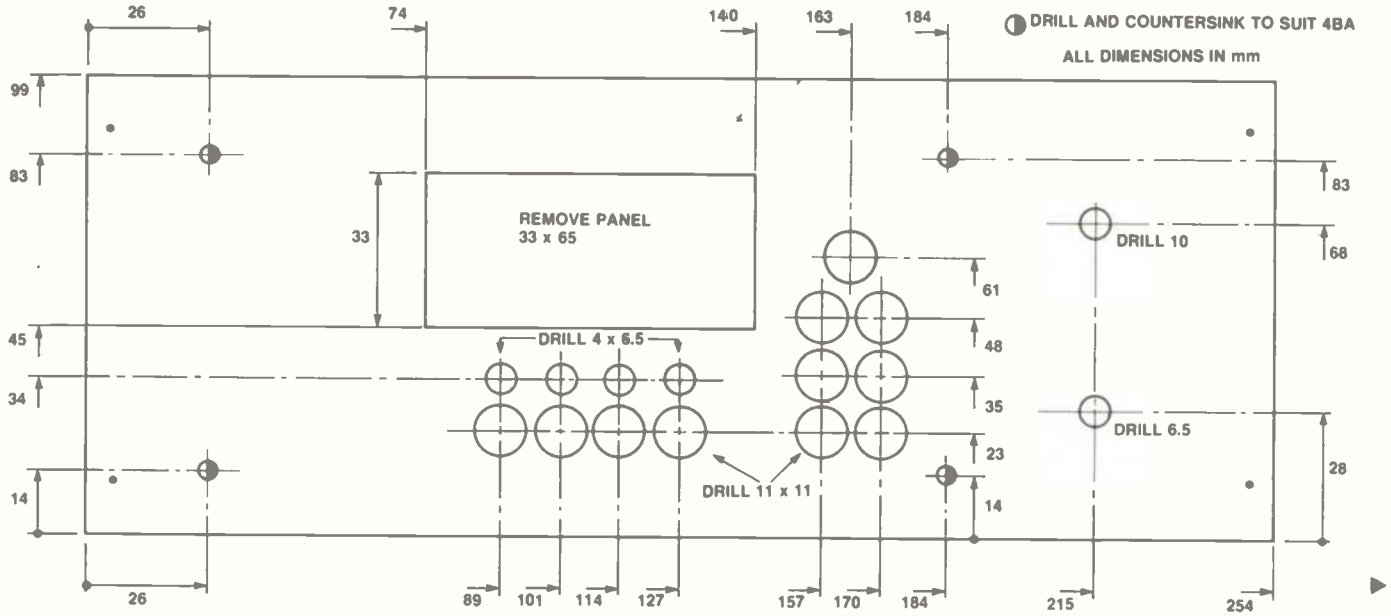
So there it is, ready to switch those lights, or whatever, according to how you program it.



Inside view. Showing the general location of the output board and power supply, prior to installing the mains wiring.

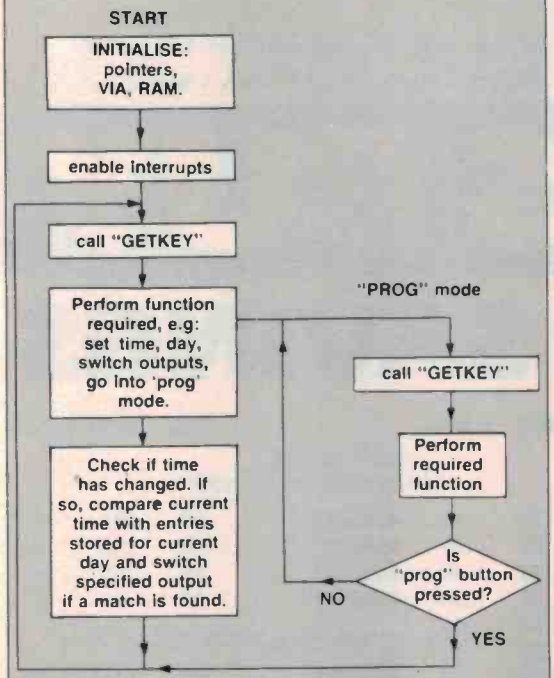
Piggyback. The display and processor boards are piggy-backed using tapped spacers, as shown here.





PROGRAM OPERATION

A full listing of the EPROM program is given on page 106.

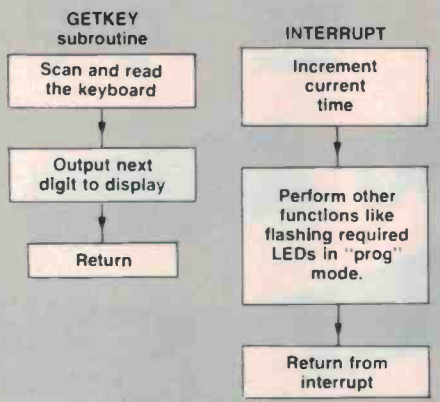


NOTE: Each entry consists of three bytes:

Byte 1: used on/off out 4 out 3 out 2 out 1
- A one (1) in either OUT 1, 2, 3 or 4 says this output is to be switched.
- A one (1) in on/off specifies output to switch on. A zero (0) specifies it to switch off.
- Used bit — zero (0) means the entry is not being used.

Byte 2: HOURS, stored as two BCD digits.

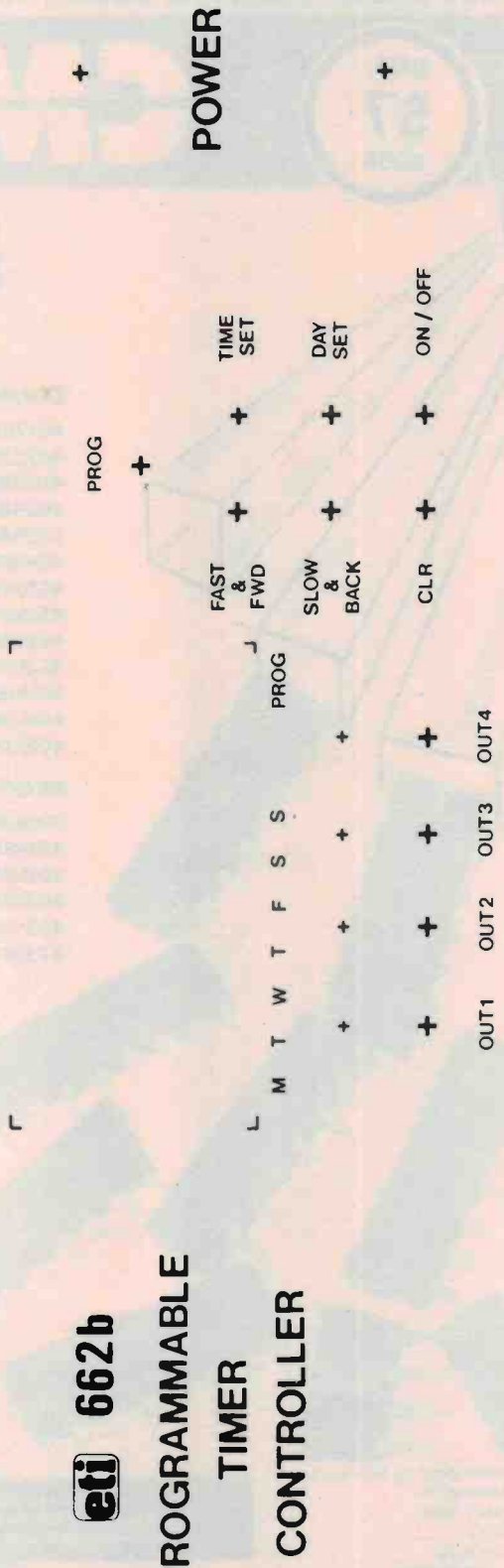
Byte 3: MINUTES, stored as two BCD digits.



*For a guide to buying components and kits see **SHOP AROUND** this issue.*

◄ Front panel drilling details.

Front panel artwork, full size. ►



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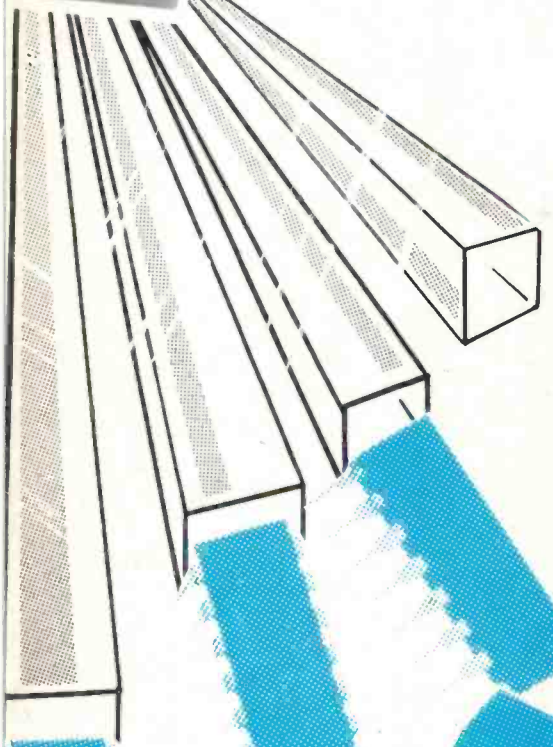
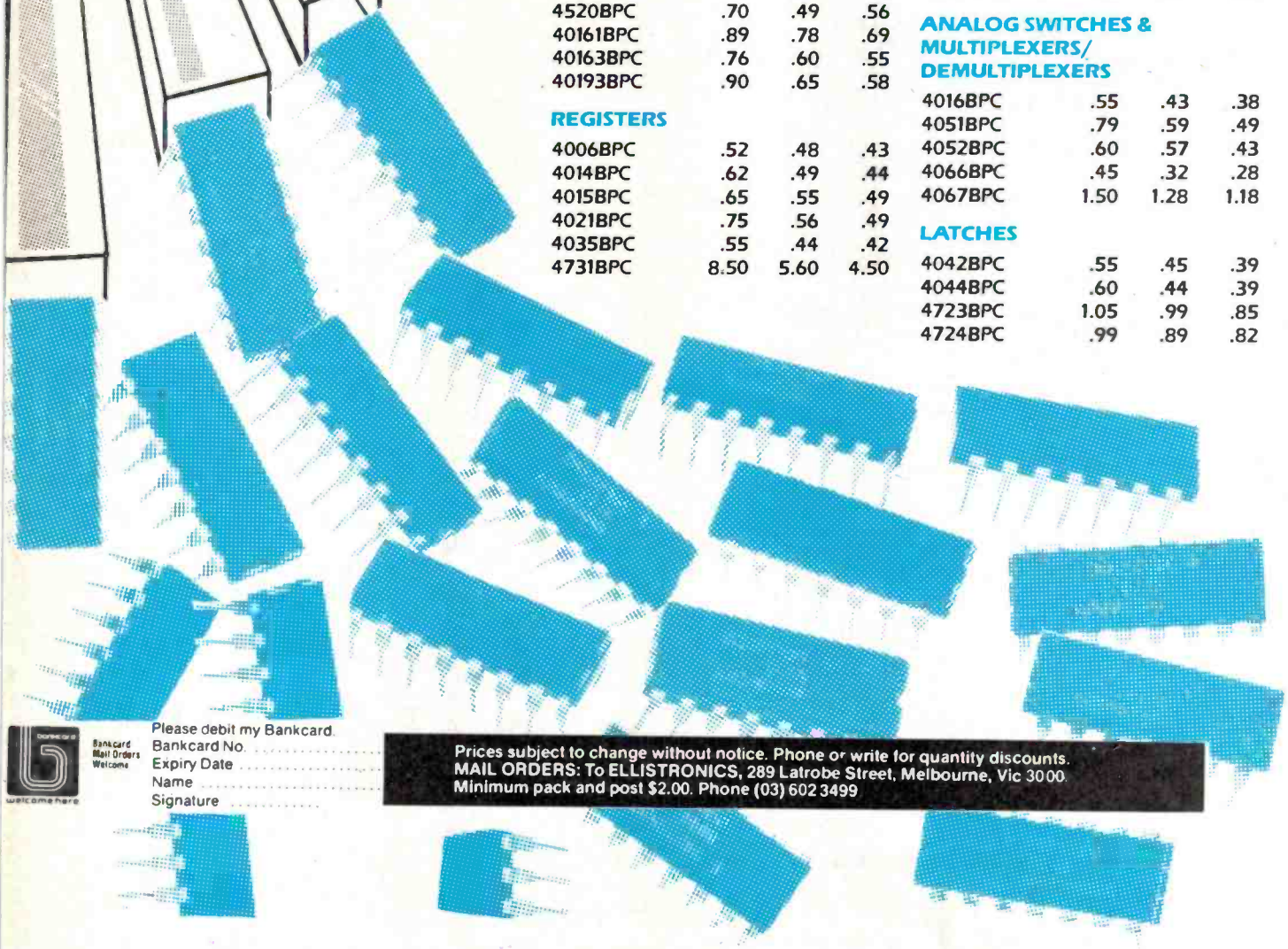


	100	500	1,000
COUNTERS			
4017BPC	.78	.58	.49
4020BPC	.76	.56	.49
4022BPC	.69	.53	.48
4024BPC	.58	.39	.35
4029BPC	.65	.54	.47
4040BPC	.76	.57	.49
4510BPC	.80	.58	.53
4516BPC	.80	.58	.54
4518BPC	.70	.49	.43
4520BPC	.70	.49	.56
40161BPC	.89	.78	.69
40163BPC	.76	.60	.55
40193BPC	.90	.65	.58
REGISTERS			
4006BPC	.52	.48	.43
4014BPC	.62	.49	.44
4015BPC	.65	.55	.49
4021BPC	.75	.56	.49
4035BPC	.55	.44	.42
4731BPC	8.50	5.60	4.50

	100	500	1,000
DECODERS/ DEMULTIPLEXERS			
4028BPC	.59	.43	.38
4511BPC	.86	.56	.54
4555BPC	.65	.55	.45
4556BPC	.48	.45	.42
DIGITAL MULTIPLEXERS			
4019BPC	.35	.33	.29
4512BPC	.53	.47	.42
4539BPC	.72	.65	.58
ANALOG SWITCHES & MULTIPLEXERS/ DEMULTIPLEXERS			
4016BPC	.55	.43	.38
4051BPC	.79	.59	.49
4052BPC	.60	.57	.43
4066BPC	.45	.32	.28
4067BPC	1.50	1.28	1.18
LATCHES			
4042BPC	.55	.45	.39
4044BPC	.60	.44	.39
4723BPC	1.05	.99	.85
4724BPC	.99	.89	.82



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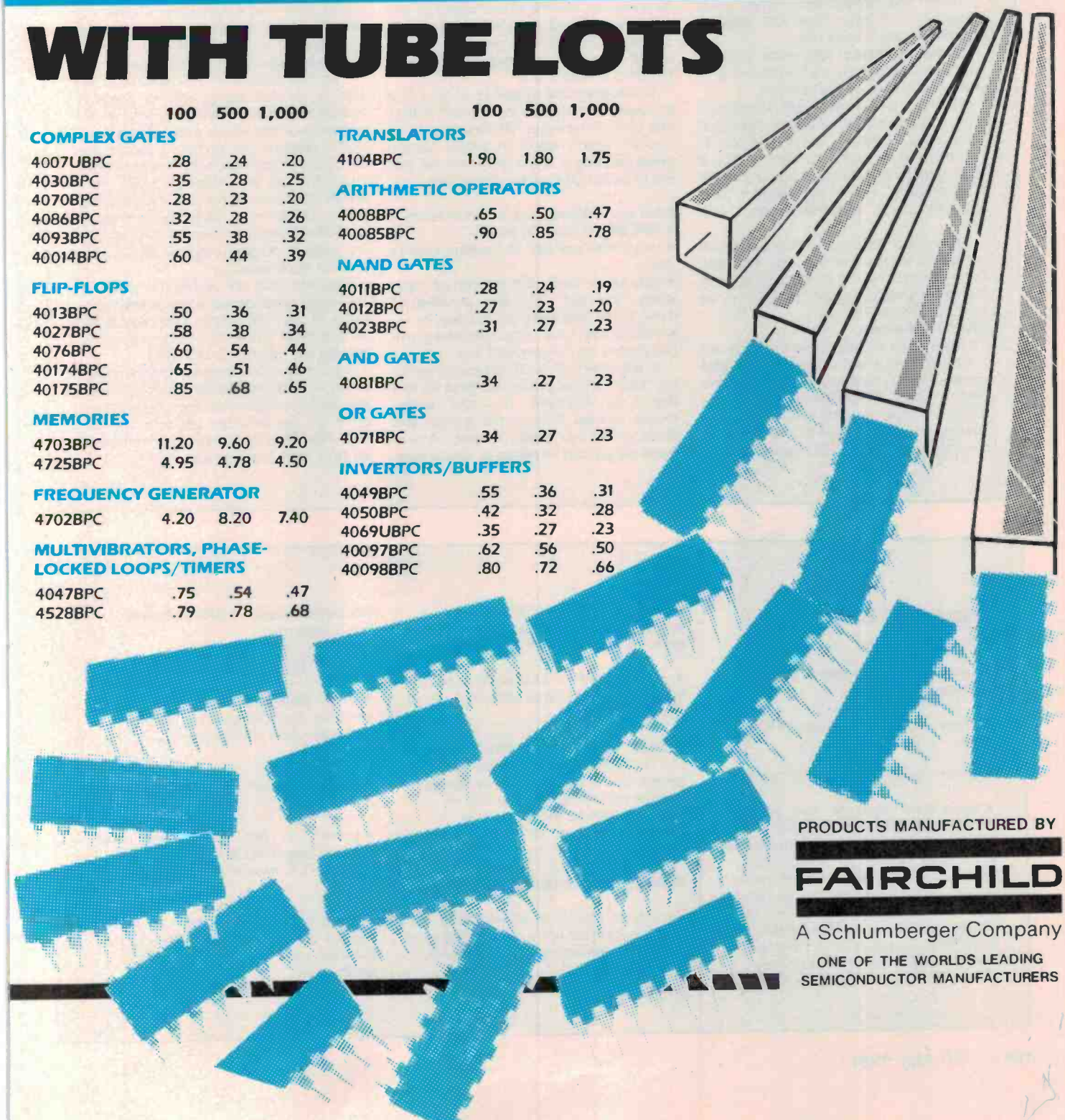
	100	500	1,000
COMPLEX GATES			
4007UBPC	.28	.24	.20
4030BPC	.35	.28	.25
4070BPC	.28	.23	.20
4086BPC	.32	.28	.26
4093BPC	.55	.38	.32
40014BPC	.60	.44	.39
FLIP-FLOPS			
4013BPC	.50	.36	.31
4027BPC	.58	.38	.34
4076BPC	.60	.54	.44
40174BPC	.65	.51	.46
40175BPC	.85	.68	.65
MEMORIES			
4703BPC	11.20	9.60	9.20
4725BPC	4.95	4.78	4.50
FREQUENCY GENERATOR			
4702BPC	4.20	8.20	7.40
MULTIVIBRATORS, PHASE-LOCKED LOOPS/TIMERS			
4047BPC	.75	.54	.47
4528BPC	.79	.78	.68

	100	500	1,000
TRANSLATORS			
4104BPC	1.90	1.80	1.75
ARITHMETIC OPERATORS			
4008BPC	.65	.50	.47
40085BPC	.90	.85	.78
NAND GATES			
4011BPC	.28	.24	.19
4012BPC	.27	.23	.20
4023BPC	.31	.27	.23
AND GATES			
4081BPC	.34	.27	.23
OR GATES			
4071BPC	.34	.27	.23
INVERTORS/BUFFERS			
4049BPC	.55	.36	.31
4050BPC	.42	.32	.28
4069UBPC	.35	.27	.23
40097BPC	.62	.56	.50
40098BPC	.80	.72	.66



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USING IT

The unit basically runs as a 24 hour clock. At any time, it can be in one of two modes — the RUN mode or PROGRAM mode.

RUN mode

This is the unit's normal mode of operation. It displays the current time, day and output status. In this mode, it increments the time each minute and increments the day every 24 hours.

To set the current time, simply press "time set" with either "fast" OR "slow" to advance to the correct time.

To set the correct day, press "day set" and step through to the correct day — each press steps to the next day.

At any time in RUN mode, the current time and day can be changed. Also, buttons "out 1", "out 2", "out 3" and "out 4" can be used to toggle the state of any of the outputs. For example if output 1 is ON then pressing "out 1" will switch it OFF. Pressing "out 1" again will switch it ON, etc.

Also, every minute, the microprocessor compares the current day and time with the entries stored. If a match is found then the entry specifies which output is to be switched ON or OFF.

PROGRAM mode:

To store times and days when outputs are to be switched, one must enter PROGRAM mode. This is achieved by pressing the "prog" button. PROGRAM mode can be exited by simply pressing the "prog" button again — it works in toggle fashion. When in this mode, the PROG LED flashes.

As soon as this mode is entered, the microprocessor searches the MONDAY entries and displays the NEXT EMPTY entry which normally appears as all output LEDs OFF and 0000 on the displays. If some other entry appears, this indicates that all 85 entries (the maximum number per day) have been programmed for that day and the last entry is the one being displayed.

To make an entry, simply set the time as previously described and select an output to be switched. If left like this, it's corresponding LED will flash indicating that the output has been programmed to switch OFF at the preset time.

To program the output to switch ON at the preset time, press the "on/off" button. The LED will now stay ON. Once again the "on/off" button works in toggle fashion since pressing it again programs the output to switch OFF at the preset time.

What you entered is stored when either:

- PROGRAM mode is exited,
- you press "day set" to program another day,
- you press "fwd" (the function of "fast" when "time set" isn't also pressed) to move to the next entry on that day, or
- if you press "back" which displays previous entries on the specified day.

At any time in PROGRAM mode, pressing "back" allows previous entries on any day to be displayed. The "fwd" button moves forward through the entries and stops at the first empty location. Any of these entries can be edited by simply moving forward or back to display it and then entering the change required. For example; for "out 1" to switch instead of "out 2" just press "out 1" to overwrite "out 2", etc.

To delete an entry, use "fwd" or "back" to find it and then simply press "clr". The display will show "CLR" as a check and if you press "clr" again, the entry will be deleted and the others shifted to take it's place. If you decide against clearing when "CLR" is displayed, just press any other button. Note that, to help locate entries, the "fwd" or "back" buttons can be held down continuously which causes each entry in turn to be displayed for a short period.

The last feature in PROGRAM mode has to do with being able to program entries for either the weekdays only, weekend only or the whole week. When "day set" is pressed, the next day's entries can be observed and modified. However, after SUNDAY, all the weekday LEDs light which allows an output and it's switching time to be stored for each day of the week AUTOMATICALLY. Pressing "fwd" allows the user to program another output and time for each weekday.

Pressing "day set" allows the weekend only to be programmed whereas one more press of "day set" allows each day to be programmed, automatically. the next press of "day set" returns to MONDAY.

Note that in this multiday programming mode, if all 85 entries on a particular day are already programmed then the multiday entry will overwrite the last entry on that day. Also, the "back" and "clr" functions do NOT work in this mode.

Programming Example

To switch output 1 ON on Tuesday at 4.00 pm.

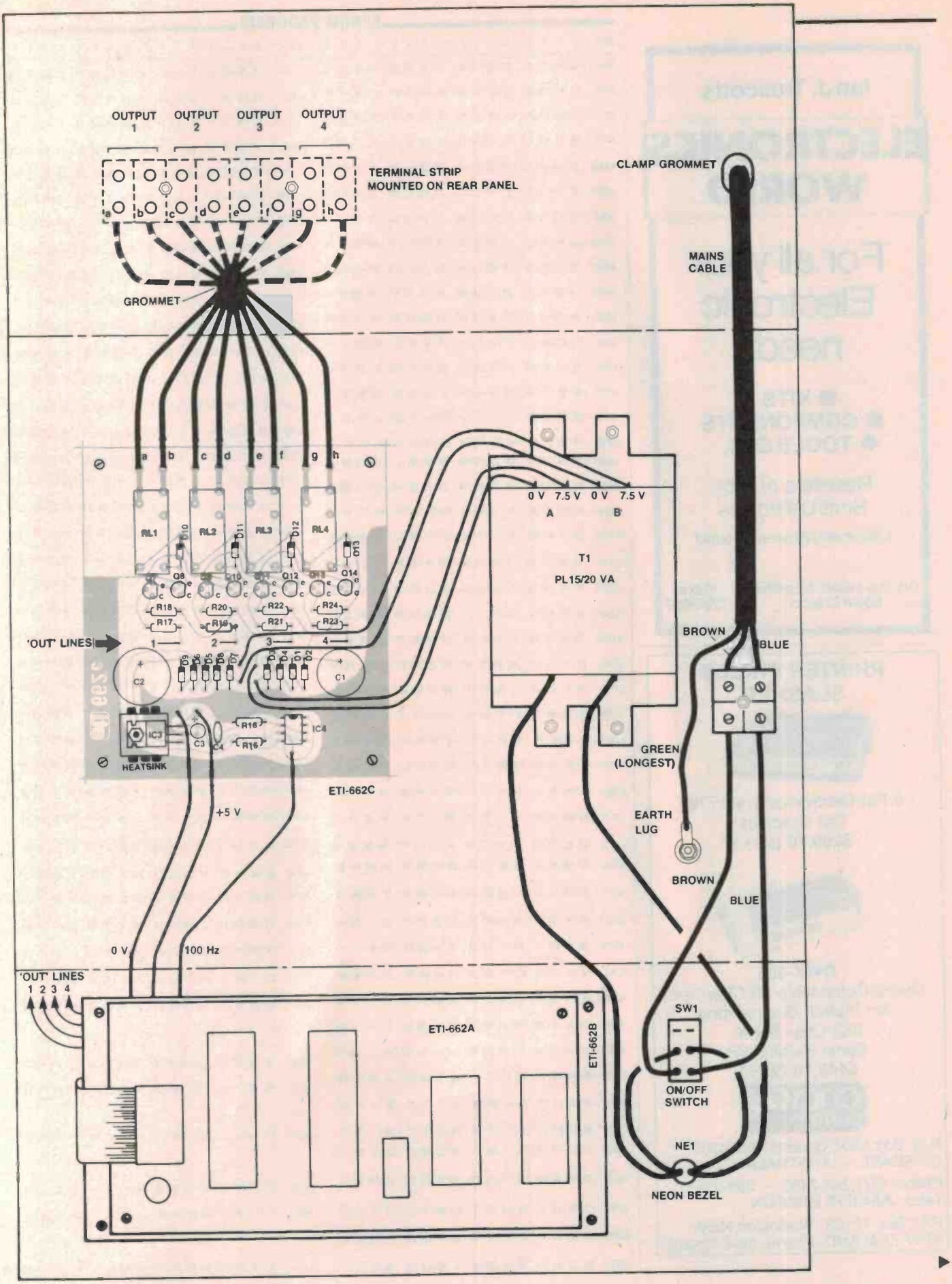
- press "prog" — to get into PROG mode.
- press "dayset" — to select Tuesday.
- press either "time set" and "fast" simultaneously or "time set" and "slow" to increment the time to 1600 (remember, this is a 24 hour clock). If you press "time set" and "slow" to increment the time to 1600 (remember, this is a 24 hour clock). If you press "time set" and fast till you get near the time, then "slow" to set exact time, always release "time set" before going to slow time advance.
- press "out1" — it's LED will flash indicating if theft like this, then it will switch off at the preset time.
- press "on/off" — LED will stay on to indicate that the output will switch ON at the specified time.
- press "prog" — to exit PROG mode or you could press "fwd" to enter other entires for the specified day or "dayset" to enter settings for another day or "back" to look at, modify or clear previous entries, or "clr" to erase the entry.

Multiday programming.

Multiday programming allows one to place an identical entry under either each weekday, weekend or the whole week AUTOMATICALLY.

To switch output 2 OFF at 3am on each weekday.

- press "prog".
- press 'dayset" seven times (to step to weekday mode indicated by the five weekday LEDs comming on).
- press "time set" etc to set time to 0300.
- press "out2" (the "on/off" button need not be pressed this time since the output is required to switch OFF at the present time).
- press "prog" to exit or you can press — "fwd" to place another entry under all the week days or "dayset" to select another day.


OUTPUT 1
OUTPUT 2
OUTPUT 3
OUTPUT 4
TERMINAL STRIP MOUNTED ON REAR PANEL
GROMMET
CLAMP GROMMET
MAINS CABLE
'OUT' LINES
HEATSINK
ETI-662C
0 V 7.5 V 0 V 7.5 V
A B
T1
PL15/20 VA
BROWN
BLUE
GREEN (LONGEST)
EARTH LUG
BROWN
BLUE
+5 V
0 V
100 Hz
'OUT' LINES
1 2 3 4
ETI-662A
ETI-662B
SW1
ON/OFF SWITCH
NE1
NEON BEZEL

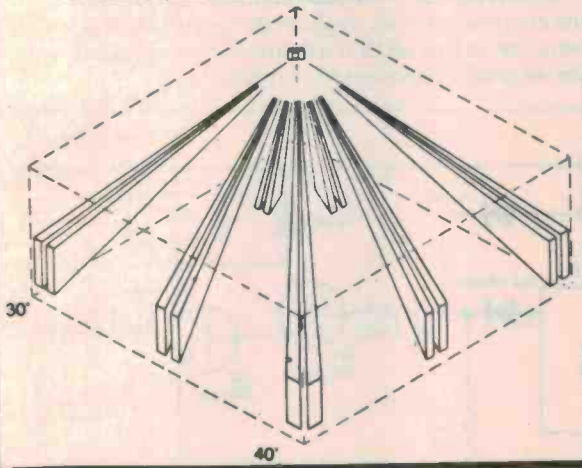
EPROM PROGRAM

Addr	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
6000:	8E	00	7F	7F	40	08	7F	40	00	86	FF	B7	40	0C	86	FC
6010:	B7	40	04	86	60	B7	40	03	86	88	B7	40	07	CE	2F	FF
6020:	6F	00	09	8C	1F	FF	26	F8	CE	00	7F	6F	00	09	26	FB
6030:	86	6F	97	12	86	6E	97	14	86	10	97	1C	0E	7D	00	2A
6040:	27	03	BD	62	30	BD	61	00	D6	2D	C1	F4	27	1E	C1	FF
6050:	27	1D	C1	F9	27	1C	C1	7D	27	1B	C1	BD	27	1A	C1	DD
6060:	27	19	C1	DE	27	18	C1	BE	27	17	20	D1	7E	60	84	7E
6070:	60	9C	7E	62	70	7E	60	C0	7E	60	D1	7E	60	D5	7E	60
6080:	D9	7E	60	DD	0F	BD	61	00	D6	2D	C1	F4	26	26	CE	00
6090:	1A	BD	61	A0	BD	61	D0	BD	60	F1	20	E9	0F	BD	61	00
60A0:	D6	2D	C1	FF	26	0E	CE	00	1A	BD	61	A0	BD	61	D0	BD
60B0:	60	E9	20	E9	7F	00	0E	7F	00	0F	0E	7E	60	3D	01	01
60C0:	96	1C	4C	81	17	26	02	86	10	97	1C	BD	61	95	7E	60
60D0:	3D	86	01	20	0A	86	02	20	06	86	04	20	02	86	08	98
60E0:	1D	97	1D	BD	61	95	7E	60	3D	86	7F	BD	61	00	4A	26
60F0:	FA	86	0F	BD	61	00	4A	26	FA	39	01	01	01	01	01	01
6100:	DF	0A	36	7F	00	2D	0F	BD	61	50	D6	11	D7	13	DE	12
6110:	E6	00	37	DE	10	BC	00	04	27	11	BC	00	05	27	08	E6
6120:	00	D7	15	DE	14	20	04	E6	00	D7	06	E6	00	F7	40	08
6130:	33	F7	40	00	DE	10	08	BC	00	06	26	03	CE	00	00	DF
6140:	10	86	FF	4A	26	FD	32	DE	0A	0E	39	01	01	01	01	01
6150:	7F	40	08	86	80	8D	1E	CA	FC	C1	FF	27	14	C6	0F	5A
6160:	26	FD	8D	11	CA	FC	C1	FF	27	EB	F6	40	00	DA	2D	D7
6170:	2D	44	26	E1	39	43	81	EF	27	04	81	7F	26	0B	D6	06
6180:	F7	40	08	B7	40	00	7F	40	08	20	03	B7	40	00	F6	40
6190:	00	43	39	01	01	BD	61	00	D6	2D	C5	03	26	F7	39	01
61A0:	A6	01	8B	01	19	A7	01	81	60	26	1E	6F	01	A6	00	8B
61B0:	01	19	A7	00	81	24	26	11	6F	00	96	2C	27	0A	96	1C
61C0:	4C	81	17	26	02	96	10	A7	02	39	01	01	01	01	01	01
61D0:	A6	00	44	44	44	44	97	00	86	0F	A4	00	97	01	A6	01
61E0:	44	44	44	44	97	02	86	0F	A4	01	97	03	DF	2E	A6	02
61F0:	97	15	DE	14	A6	00	7D	00	0C	26	11	97	04	DE	2E	A6
6200:	03	8A	30	97	13	DE	12	A6	00	97	05	39	D6	04	C4	80
6210:	D7	04	9A	04	97	04	DE	2E	A6	03	8A	40	97	13	DE	12
6220:	A6	00	C6	B8	D4	05	D7	05	9A	05	97	05	39	01	01	01
6230:	96	1C	8A	30	84	27	97	07	7F	00	08	DE	07	A6	01	91
6240:	1A	26	1B	A6	02	91	1B	26	15	A6	00	85	20	27	08	84
6250:	0F	9A	1D	97	1D	20	07	84	0F	43	94	1D	97	1D	08	08
6260:	08	A6	00	85	80	26	D6	7F	00	2A	39	01	01	01	01	01
6270:	7C	00	0C	86	10	97	22	BD	64	10	96	22	81	16	23	03
6280:	7E	62	8E	48	8A	10	97	3F	DE	3E	EE	00	DF	25	BD	64
6290:	62	BD	61	95	BD	61	00	D6	2D	C1	7E	27	2E	C1	F6	27
62A0:	2D	C1	F4	27	2C	C1	FF	27	2B	C1	7D	27	2A	C1	EE	27
62B0:	29	C1	F9	27	28	C1	BD	27	27	C1	DD	27	26	C1	DE	27
62C0:	25	C1	BE	27	24	C1	ED	27	23	20	C9	7E	62	F0	7E	63
62D0:	20	7E	63	55	7E	63	6C	7E	63	86	7E	63	97	7E	63	D7
62E0:	7E	63	E3	7E	63	E7	7E	63	EB	7E	63	EF	7E	63	F8	01
62F0:	96	22	81	16	23	03	7E	62	91	BD	64	90	7D	00	26	27

Addr	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
6300:	18	7A	00	26	7A	00	26	7A	00	26	BD	64	62	BD	60	E9
6310:	BD	61	00	D6	2D	C1	7E	27	E3	7E	62	8E	01	01	01	01
6320:	BD	64	90	96	22	81	16	23	03	7E	62	77	96	26	81	FC
6330:	27	20	DE	25	A6	00	85	80	27	18	7C	00	26	7C	00	26
6340:	7C	00	26	BD	64	62	BD	60	E9	BD	61	00	D6	2D	C1	F6
6350:	27	DA	7E	62	8E	BD	61	00	D6	2D	C1	F4	26	25	CE	00
6360:	20	BD	61	A0	BD	61	D0	BD	60	F1	20	E9	BD	61	00	D6
6370:	2D	C1	FF	26	0E	CE	00	20	BD	61	A0	BD	61	D0	BD	60
6380:	E9	20	E9	7E	62	91	BD	64	90	96	22	4C	81	1A	26	02
6390:	86	10	97	22	7E	62	77	96	22	81	16	23	03	7E	62	91
63A0:	CE	CD	EF	DF	20	BD	61	95	BD	61	00	D6	2D	CA	FC	C1
63B0:	FC	27	F5	D6	2D	C1	EE	27	03	7E	62	8E	DE	25	DF	0A
63C0:	96	0B	81	FF	27	F3	E6	03	E7	00	E6	04	E7	01	E6	05
63D0:	E7	02	08	08	08	20	E7	7F	00	0C	BD	64	90	BD	61	95
63E0:	7E	60	3D	86	01	20	0A	86	02	20	06	86	04	20	02	86
63F0:	08	97	23	97	24	7E	62	91	7D	00	29	27	05	7F	00	29
6400:	20	03	7C	00	29	7E	62	91	01	01	01	01	01	01	01	01
6410:	CE	20	00	BD	64	50	DF	30	CE	21	00	BD	64	50	DF	32
6420:	CE	22	00	BD	64	50	DF	34	CE	23	00	BD	64	50	DF	36
6430:	CE	24	00	BD	64	50	DF	38	CE	25	00	BD	64	50	DF	3A
6440:	CE	26	00	BD	64	50	DF	3C	39	01	01	01	01	01	01	01
6450:	A6	00	85	80	27	08	08	08	08	DF	25	96	26	81	FC	26
6460:	EF	39	96	22	81	16	23	0A	4F	97	20	97	21	97	23	97
6470:	24	39	DE	25	A6	00	7F	00	29	85	20	27	03	7C	00	29
6480:	84	0F	97	23	97	24	A6	01	97	20	A6	02	97	21	39	01
6490:	96	24	26	01	39	96	22	81	17	27	0E	81	18	27	24	81
64A0:	19	27	2B	DE	25	BD	64	D5	39	DE	30	BD	64	D5	DE	32
64B0:	BD	64	D5	DE	34	BD	64	D5	DE	36	BD	64	D5	DE	38	BD
64C0:	64	D5	39	DE	3A	BD	64	D5	DE	3C	BD	64	D5	39	BD	64
64D0:	A9	BD	64	C3	39	96	20	A7	01	96	21	A7	02	96	24	7D
64E0:	00	29	27	02	8A	20	8A	80	A7	00	39	01	01	01	01	01
64F0:	DE	0E	08	8C	17	70	26	12	86	FF	97	2C	97	2A	CE	00
6500:	1A	BD	61	A0	7F	00	2C	CE	00	00	DF	0E	96	0C	27	33
6510:	D6	0F	C5	10	27	08	96	04	8A	80	97	04	20	06	96	04
6520:	84	7F	97	04	96	29	26	0B	D6	0F	C5	20	26	05	7F	00
6530:	23	20	04	96	24	97	23	CE	00	20	BD	61	D0	86	FF	B7
6540:	40	0B	3B	CE	00	1A	BD	61	D0	86	FF	B7	40	08	3B	01

6E00:	3F	30	5E	7C	71	6D	6F	38	7F	79	00	00	0F	03	42	40
6E10:	08	10	20	02	04	01	40	3E	41	7F	FF	FF	FF	FF	FF	FF
6F00:	10	80	08	04	40	20	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
6F30:	00	12	0C	1E	81	93	8D	9F	60	72	6C	7E	E1	F3	ED	FF
6F40:	00	02	04	00	01	00	00	00	40	00	00	00	00	00	00	00
6FF0:	50	2E	20	49	48	4E	41	54	64	F0	60	00	60	00	60	00

JAYCAR No.1 FOR BURGLAR ALARMS & ACCESSORIES



INFRA-RED MOVEMENT DETECTOR

The infra-red or IR detector for short, falls into the Black magic category. It basically is a high gain passive tuned receiver of a particular IR band. The heart of the unit consists of a high gain lens (antenna?) which has a "Commutated" field of view. Its reception pattern is comb-like, but highly tuned to the IR wavelength of human bodies.

When a human passes within proximity of the pickup area, the lens will selectively pick up IR radiation and then not. Movement across the pickup area will result in a series of pulses sent to a detector circuit.

IR detectors are very reliable as they do not transmit and will not respond to non heat radiating objects. Curtains for example, can wave about without tripping the alarm. Even the cat is unlikely to trip the unit.

The "Arrowhead" is the latest of a series of IR detectors that we have sold. It represents the latest developments.

FEATURES:

- 12V DC powered
- Small 4½" x 2" x 1½"
- Double sensor
- Computerised QC to lower failure rate
- Built in test lamp
- Tamper switch included
- Alarm output SPST 30V DC @ 1A

Cat. LA-5017

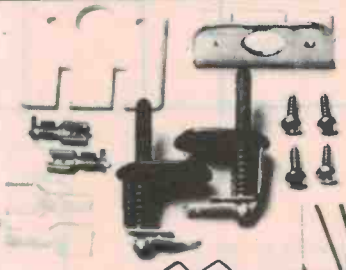
$129.50

DOOR/BOOT/BONNET SWITCH SET

European made set consisting of two spring-mounted switches with plastic actuators, two neoprene seals, two sturdy brackets, QC female connectors, boots, self-tapping screws and instructions. Switches are normally open (i.e. when boot/bonnet/door is closed). They close circuit when any of the above is opened.

Cat. LE-8776

$3.95



KEYSWITCH - SPECIAL AUTOMOTIVE TYPE

This unit features rugged neoprene rubber boot that clips over the weather-exposed part of the switch. Two special tube-type keys are included. A relatively small ½" (12mm) hole needs to be drilled in the metalwork

Cat. SM-1032

$4.95

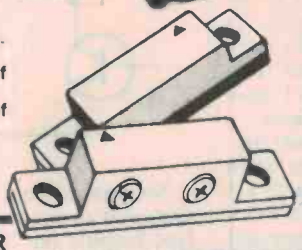
REED SWITCH/MAGNET ASSEMBLIES -

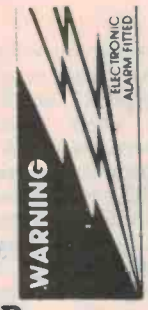
Powerful magnets. Self-adhesive or screw mount. Two types available:

NORMALLY CLOSED (when in proximity of magnet) Cat. LA-5070

NORMALLY OPEN (when in proximity of magnet) Cat. LA-5071

Both $2.95 each (1-9)
$2.50 each (10 plus)





4 SECTOR ALARM MODULE

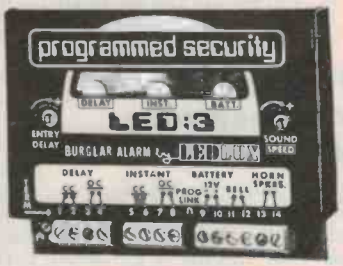
Ledlux is an alarm module suitable for both household and commercial use.

FEATURES:

- Adjustable entry delay time
- Fixed double exit time on 2 delay sectors - 70 seconds On 2 instant sectors 7 seconds
- Inbuilt silent seal test on sectors shown by 2 Red LEDs
- Inbuilt power on signal and battery voltage monitor shown by green LED
- Inbuilt siren driver. Can drive 3 horn speakers and 1 bell
- Adjustable sound speed from - a slow wail to fast warble
- Adjustable sound time (when alarm is triggered) from 1-20 mins (pre-set at 10 mins)
- Size 110 x 85 x 20mm fully insulated
- Operation voltage 6-16V nominally 12V
- Operation current 600mA so can be used with dry batteries

Cat. LA-5160

$75.00



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ALARM STICKER

Durable self-adhesive sticker that clearly tells would-be thieves there is an alarm fitted. Sticker does not refer to a specific alarm which creates further doubt.

Cat. LA-5100

95¢ each 1-9 85¢ each 10

LOW COST KEYLESS AUTO ALARM - A NEW PRODUCT FROM JAYCAR

AMAZING VALUE FOR MONEY - ★ Automatic - No keys - No switches ★ Siren Horn INCLUDED in price ★ Output to drive car horn relay ★ N.C. circuit loop ★ N.O. circuit loop ★ 23 seconds (approx) exit delay ★ 10 seconds (approx) entry delay ★ Auto reset ★ Comprehensive instruction/installation manual

Cat. LA - 5315

ONLY $49.95

ALARM CONTROL MODULE

Ideal for the home, business and factory/warehouse. Control module allows soundless entry and exit. Automatic alarm re-set, 12V DC operation, both normally open for heat, smoke, vibration and normally closed for, doors, windows etc.

- Exit delay approximately 20 seconds
- 10 second closed circuit delayed alarm
- Instant alarm for open circuit
- Auto re-set
- Power 12V DC
- Current drain 2mA system armed

Cat. LA-5030

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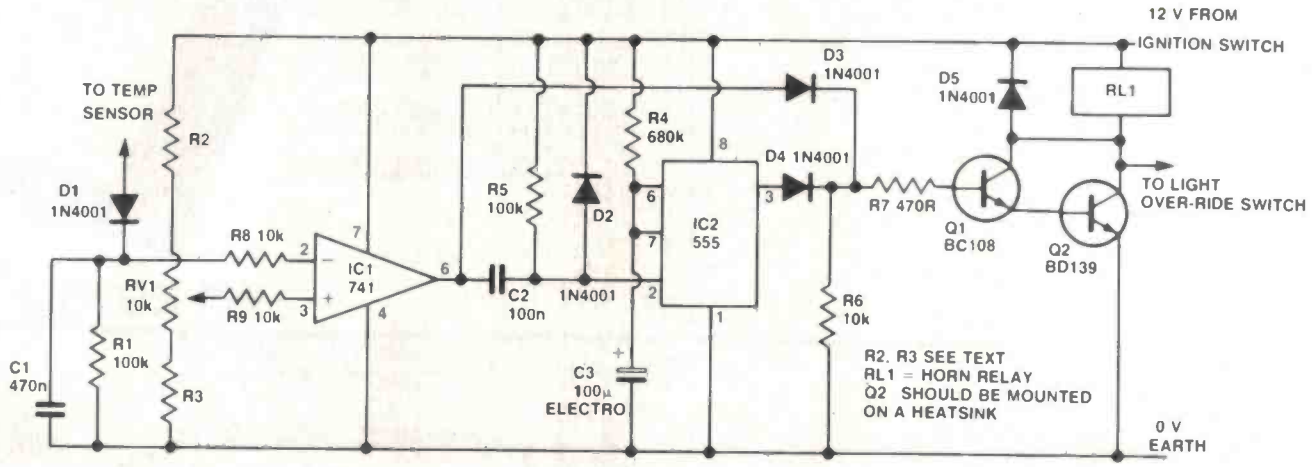
These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.



Thermatic fan control

L. Lawrence of Sanderson NT has designed a thermatic fan control which is relatively universal for any vehicle.

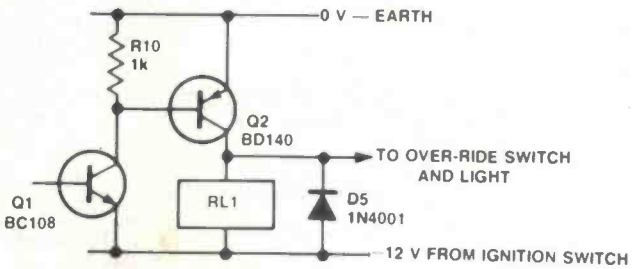
The circuit was designed because the original sensor supplied with the fan failed. The only requirement of the vehicle is that it must have electronic temperature sensing, and not 'go — no go' sensing.

D1, C1 and R1 form a sample and hold circuit for vehicles with pulsing voltage stabilisers for the instruments e.g: some Ford models. IC1 is in a voltage comparator configuration with RV1 setting the switching voltage.

R2 and R3 are chosen to give a suitable range for RV1 to operate in particular vehicles. In the prototype R2 and R3 were not used, which meant that small movements of RV1 gave large temperature variations.

C2 and R5 ensure a short trigger pulse to the 555 timer when pin 6 of IC1 goes low, while D2 prevents damage to IC2 when IC1 goes high. IC2 is connected in the monostable configuration and C2 and R4 set the delay to about one minute.

D3, D4 and R6 form an OR gate to drive the Darlington coupled Q1 and Q2 relay driver pair. D5 is to prevent damage to the relay driver Q2.



No power supply decoupling was used in the original prototype because the 741 is working in the comparator configuration. R8 and R9 were used as links to connect the 741 inputs so that the comparator switched in the correct direction.

With RV1 connected to pin 3 of IC1, the temperature sensor must go negative for correct operation of the circuit. For sensors that go positive for higher temperatures, connect the circuit the other way around.

The circuit was designed for negatively earthed vehicles but can be adapted for positive earth vehicles by modifying the circuit as shown. The fan will run for about one minute after the engine is started.

Joystick modifications for ETI-660

This joystick modification for the ETI-660 microcomputer was designed by **Peter Easdown** of Kew NSW. It only requires one Atari type joystick and six lengths of hookup wire.

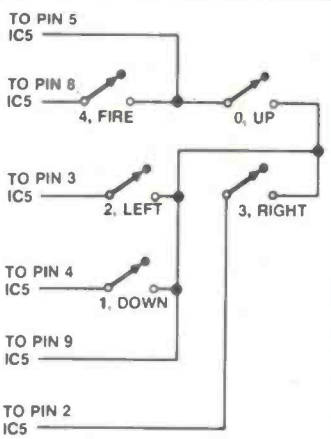
The idea came to me when mum kept complaining that she couldn't remember which buttons to press when she was in the middle of an exciting game of Lunar Blitz.

I thought about a proper modification hooked to socket J2, but this would probably require a new ROM. So why not hook it up to the keyboard? Then you would only need to use the same keyboard reading commands and it would not require any new RAM, ROM or ICs.

You will have to make one change in the joystick itself — disconnect the wire that goes to common from the fire button and reconnect it to the wire that comes from pin 5 of IC5.

When writing a program to use with the joystick, use the following values in the commands for different movements of the joystick: fire button-4; up-0; down-1; left-2; right-3.

Although it's not a fancy or complicated modification, I think it will make the games more realistic to play and satisfy all those modification-hungry 660 builders like myself.



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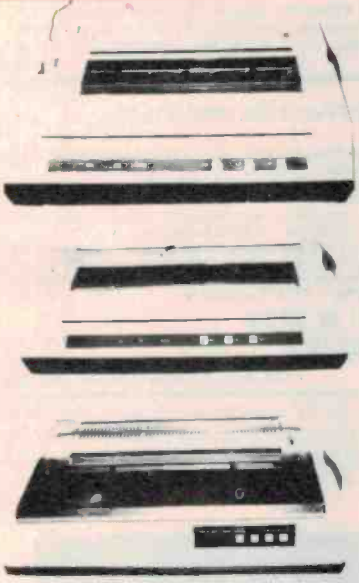

Pro/Writer Printer 8510

Print Features: Number of columns—136 col. max. Print Speed—120 CPS. Print Direction—Single-directional and Bidirectional, Switch Selectable. Throughput Speed—From 44 to 152 lpm. Character spacing (max. number of columns per line)—Pica 10 CPI (80), Double Width 5 CPI (40), Compressed Font 17 CPI (136), Double Width 8.5 CPI (68), Elite 12 CPI (96), Double Width 6 CPI (48), Proportional, Double Width Proportional, Line Spacing—Variable to 1/144". Print Width—203 mm (8") max.
Forms Type: Fan Fold Roll or Cut Sheet: Width—113 mm to 254 mm (4.5" to 10.0"). Total Thickness—0.05 to 0.28 mm (0.002" to 0.011"). Number of Copies—Original + 3 copies nominal.
Form Feed: Method—Tractor or Friction. Form Loading—Either rear or top.
Interface—Serial: Method—EIA RS232-C and 20mA (40 & 60mA switchable option) Current Loop Serial Interface. Baud Rate (BPS)—110, 300, 600, 1200, 2400, 4800, 9600. Transmitting Method—Half Duplex, Synchronization—Asynchronous.
Interface—Parallel: Method—TTL compatible, 7-bit, parallel interface. Control Signals—ACK, BUSY, SELECT, DATA STB, INPUT PRIME FAULT, INPUT BUSY, PAPER EMPTY. Instruction Codes—(ASCII): CR, LF, VT, FF, CAN, SO, SI, DEL, DC1, DC2, DC3, DC4, GS, RS, US, FS, EM; GRAPHIC SYMBOLS; BIT GRAPHICS.
Error Detection: (1) Parity (VRC)—Odd, Even, No-parity. Switch selectable. (2) Framing Error—Stop bit check. (3) Overrun Error—Error is detected when data are received before the previous data have been processed.
Physical dimensions: 398 mm W x 120 mm H x 285 mm D (18.7" W x 4.7" H x 11.2" D).
Weight: 8.5 kg (18 lbs. 12 oz.)

tax exempt

P* $795 ($695)
S** $1095 ($945)

Model 1550

The Model 1550 is a compact desk-top dot matrix serial impact printer used for data communication terminals, hardcopy of CRT displays, peripheral terminals for minicomputers and microcomputers, and small-sized business systems.
The character format is a dot matrix of 7(H) x 9(V) or 8(H) x 8(V).
Print speed is 120 characters/second. Up to 136 characters can be printed per line at 10 CPI.
Its main features are: ● Compact desk-top dot matrix printer ● 136-column print ● Light-weight ● Low power-consumption ● High-quality print ● Bit image graphics ● Graphic Symbols ● Prints in six different languages ● High reliability ● Low cost.

P* $1095 ($995)
S** $1395 ($1295)

F-10 Printmaster Daisy Wheel Printer

Print Speed: 40 CPS. **Print Method:** Static Print Impact. **Number of Printable Columns:** 136, 163, Variable. **Character Spacing:** 1/120 Inch (minimum). **Line Spacing:** 1-48
Return Time: 900 msec. **Line Feed Time** 40 msec. **Paper Width:** 406 mm (maximum)
Print Characters: 96. **Printwheel:** Industry Standard 96 Character Wheel. **Interface:** Industry Standard 8-bit Parallel, RS232-C Compatible, X-ON, X-OFF, 12-bit Qume and Diablo Compatible. **Dimensions:** 574 mm W x 405 mm d x 153.5 mm H (22.5" W x 15.9" D x 6" H). **Weight:** 14 kg (30.8 lbs.) with cover and power supply. **Noise:** Less than 65 Db (1M from Platen, A Scale).

P* $1950 ($1675)
S** $2200 ($1875)

* Parallel Interface ** Serial Interface

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Computer data and graphic displays never looked better, brighter, sharper

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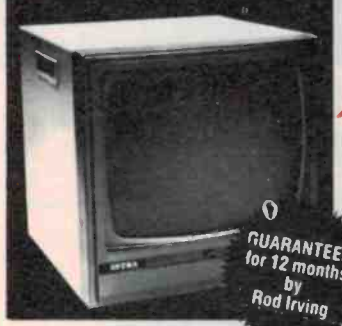

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A NEW PRINTER NOW!

CP-80/I, 80-COLUMN IMPACT PRINTER

SPECIFICATIONS

Functional Specifications

Printing method — Serial impact dot matrix.
Printing format — Alpha-numeric — 7 x 8 in 8 x 9 dot matrix field. Semi-graphic (character graphic) — 7 x 8 dot matrix. Bit image graphic — Vertical 8 dots parallel horizontal. 640 dots serial/line.
Character size — 21 mm (0.083")-W x 2.4 mm (0.09")-H 7 x 8 dot matrix.
Character set — 228 ASCII characters. Normal and Italic alpha-numeric fonts, symbols and semi-graphics.
Printing speed — 80 CPS 640 dots/line per second.
Line feed time — Approximately 200 msec at 4.23 mm (1/6") line feed.
Printing direction — Normal — Bidirectional logic seeking. Superscript and bit image graphics — Unidirectional left to right.
Dot graphics intensity — Normal — 640 dots 190.5 mm (7.5") line horizontal. Compressed characters — 1,280 dots 190.5 mm (7.5") line horizontal.
Line spacing — Normal — 4.23 mm (1/6"). Programmable in increments of 0.35 mm (1/72") and 0.118 mm (1/216").
Columns/line — Normal size — 80 columns. Double width — 40 columns. Compressed print — 142 columns. Compressed double width — 71 columns. The above can be mixed in a line.
Paper feed — Adjustable sprocket feed and friction feed.
Paper type — Fanfold Single sheet. Thickness — 0.05 mm (0.002") to 0.25 mm (0.01"). Paper width — 101.6 mm (4") to 254 mm (10").
Number of copies — Original plus 3 copies by normal thickness paper.

Mechanical Specifications

Ribbon — Cartridge ribbon (exclusive use), black.
MTBF — 5 million lines (excluding print head life).
Print head life — Approximately 30 million characters (replaceable).
Dimensions — 377 mm (14.8") -W x 295 mm (11.6") -D 125 mm (4.9") -H (incl. sprocket cover.

Parallel CP80 $359
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• 1% Metal Film Resistors are used where possible • Prewound Coils are supplied • Aluminium case as per the original article • All components are top quality • Over 400 Kits now sold • We have built this unit and so know what needs to go into every kit • SUPER FINISH Front panel supplied with every kit at no extra cost to you. • We are so confident of this kit that we can now offer it assembled and tested so that people who do not have the time can appreciate the sound that this amplifier puts out. This is done on a per order basis delivery approx. four weeks after placement.

PREAMPLIFIER **Only $449**

KIT PRICE $289 P&P $12.00

• 1% Metal Film Resistors are supplied • 14 metres of Low Capacitance Shielded are supplied (a bit extra in case of mistakes) • English "Lorlin" Switches are supplied no substitutes as others supply • We have built and tested this unit and so know what needs to go into every kit • Specially imported black anodised aluminium knobs • Again as with the power amp we are offering this kit A & T at a price which we do not believe there is a commercial unit available that sounds as good. Same delivery as the PA.

PREAMPLIFIER Kit Price $289, P&P $12.00

SPECIFICATIONS

Frequency response:	High-level input: 15Hz-130 kHz, +0, −1 db Low-level input — conforms to RIAA equalisation, ±0.2 dB
Distortion:	1kHz <0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation).
S/N noise:	High-level input, master full, with respect to 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 ohm source resistance connected: >86 dB flat >92 dB A-weighted. MC input, master full, with respect to full output (1.2V) and 200 μV input signal: >71 dB flat >75 dB A-weighted.

On Special at $259
Normally $289

**All parts available separately for both kits.*

POWER AMPLIFIER Kit Price $319, P&P $12.00

SPECIFICATIONS 150W RMS into 40ohms

Power output:	100W RMS into 8 ohms (±55 V supply).
Frequency response:	8 Hz-to 20 kHz, +0−0.4 dB 2.8-Hz to 65 kHz, +0−3 dB. NOTE: These figures are determined solely by passive filters.
Input sensitivity:	1V RMS for 100W output.
Hum:	−100dB 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 4 A continuous. <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

Please note that the "Superb Quality" Heatsink for the power amp was designed and developed by Rod Irving Electronics and is being supplied to other kit suppliers. This product cost $1,200 to develop so that your amplifier kit would have a professional finish as well as sound.

On Special at $299
Normally $319

MX-1200 MICROPHONE/AUDIO MIXER

This unit features: 12 microphone line inputs with pan, bass, treble, effect and foldback controls for each channel • LED peak indicators for each channel • 2 turntable inputs with cross-fade and individual output controls • master equaliser for bass, midrange and treble • variable headphone output etc. etc. • complete with carrying case.

SPECIFICATIONS

INPUTS
Level/Impedance Mic .46 db/1K
Line .22 db/16K x 12
Phono .52 db/50K STEREO x 2 (2mv) at 1KHz
Effect Return (Aux) .20 db/50K x 1
OUTPUTS
Level/Impedance L & R 0 db/2K
Effect Send 0 db/2K F/B Out 0 db/2K
Head phone Stereo +10 db/600 (100 .1K)
EQUALISATION
Channel
Bass ±15db
Treble ±15db
Master
Bass ±12db
Treble ±10db
Middle ±12db

FADER & CONTROLLERS
12 channel faders: Slide, 60mm, LOG 25%
2 Master fader; Slide, 60mm; LOG 15%
12 F/B Volume, 300, LIN
1 F/B Master level, 300, LIN
12 Effect Send, 300, LIN
1 Effect Return, 300, LOG 15%
2 Phono, 300, LOG 15%
1 Head Phone, 300, LOG 15%
S/N, 58DB
FREQUENCY RESPONSE 20-20 KHz
TOTAL HARMONIC DISTORTION Less than 0.1%
METER 2 illuminated VU Meters 0db = 0.775V
PEAK INDICATOR 12 LED Peak Indicators
VOLTAGE: 240 VAL 50Hz
POWER CONSUMPTION: 7.2 watts
DIMENSIONS 620 (W) x 385 (D) x 108 (H) mm (supplied complete with carrying case)

THIRD OCTAVE GRAPHIC EQUALIZER

SPECIFICATIONS E.T.I. Dec. 1982

Bands:	28 Bands from 31.5 Hz to 16 kHz
Noise: 20 kHz bandwidth	<0.008 mV, sliders at 0, gain at 0 (−102 dB),
Distortion:	0.007% at 300 mV signal, sliders at 0, gain at 0; max. 0.01%, sliders at minimum.
Frequency Response:	12 Hz-105 kHz, +0, −1 dB, all controls flat.
Boost & Cut:	14 dB

$195.00 1 Unit
$379.00 2 Units

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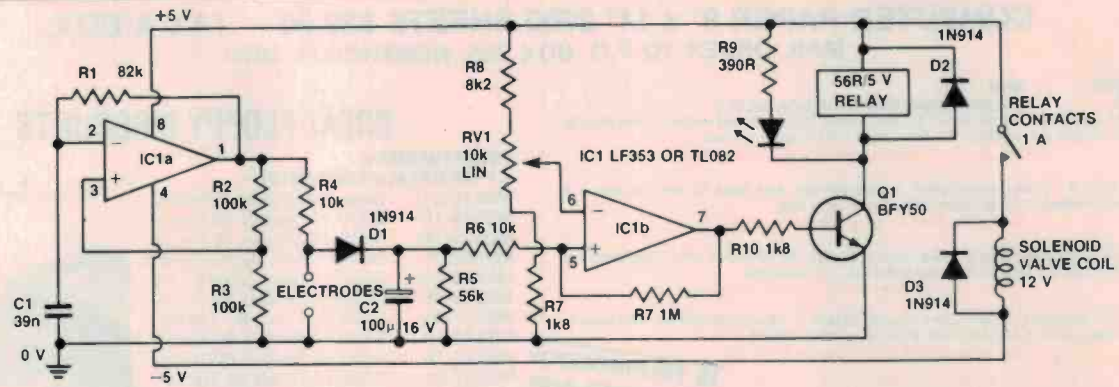
Telex AA 38897

IDEA OF THE MONTH



Automatic watering system

C. B. Kemp

An annoying characteristic of most timed watering systems is that they water in the rain, hail or sunshine.

This system for shade houses monitors the moisture level in a sample pot. When the moisture level reaches a preset trigger level the watering system is turned on.

The circuit consists of a dual FET-input op-amp in which one is wired up as a simple relaxation oscillator. The output of the oscillator is applied across a voltage divider network comprising R4 and the moisture sensing electrodes. The voltage at the top of the electrodes is rectified by D1 and smoothed by the parallel C2/R5 network. This dc voltage is fed to the non-inverting input of the second op-amp which is operated as a comparator.

The trigger level is adjusted by RV1 and this sets the moisture level at which the system turns on.

The comparator output is buffered by Q1 which drives the relay and the 'on' indicator LED. The relay contacts operate a 12 V dc solenoid valve and are protected from arcing by D3. The solenoid valve is a 12 V dc type obtained from Goyen Controls, 152 Ipswich Rd, Woolloongabba Brisbane Qld. (07)391-4558.

The value of R4 that I have used seems to suit pots of 100-150 mm diameter using a standard commercial potting mix and a slow-release fertiliser, 'Osmocote'. Because of the capacitance across the electrodes, a large value for R4 triangulates the oscillator waveform and lowers its peak value.

The electrodes are made from two pieces of blank copper-clad pc board with dimensions of 50 mm x 10 mm. Alternatively, the electrodes may be simply 50 mm off the ends of 7.5 A figure-8 cable which has been stripped of its insulation. As an ac voltage is applied across the electrodes corrosion is minimal. The electrodes that I use have been in a pot for at least five months with no appreciable sign of corrosion.

I placed one electrode horizontally across the bottom of the pot — poking it through one of the drain holes. I positioned the other electrode vertically, down the side against the wall of the pot. This makes sure that the soil is moist from the top to the bottom, and not just across the top of the pot.

The plants are not adversely affected by the ac signal so it is best to use a pot containing a typical plant. Insert the electrodes, wet the soil to a reasonable degree, turn the wetness control until it just turns on and wind it back to turn if off. Put your sample pot in an average position and sit back, relax and watch it work. My plants have not looked back.

'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** .....

Scope Panavise Multi-Purpose Work Centre.

PRIZE WORTH $90!

Scope Laboratories, which manufactures and distributes soldering irons and accessory tools, is sponsoring this contest with a prize given away every month for the best item submitted for publication in the 'Ideas for Experimenters' column — one of the most consistently popular features in ETI Magazine. Each month, we will be giving away a Scope Panavise Multi-Purpose Work Centre, Model 376/300/312, comprising a self-centering head (376), standard base (300) and tray base mount (312), all worth about $90! 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.

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M4854
Slimline 5¼" disk drive, Double sides, double density, 96 track/inch, 9621 bits/inch, 1.6 mbytes unformatted, 3ms track to track access, 77 track/side.
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M4853
Slimline 5¼" disk drive, Double sides, double density, 1 mbyte unformatted, 3ms track to track, 80 track/side, 5922 bits/inch, Steel band drive system.
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8016	Blue on White Plastic	250mm x 300mm		$48.00(10sh)
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8500	1 Litre Developer			$9.00 per bottle
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All prices plus Sales Tax. Dealer and Trade inquiries welcome.
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100MHz Probe Sets, great value @ ..... $23.00 + Tax

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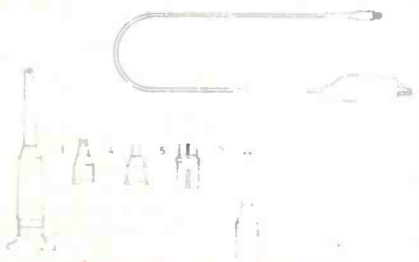
Standard Kit

Items 1-6 are standard accessories supplied where appropriate with probe kits.

1. Earth lead and clip 6"
2. Retractable hook.
3. I.C. test tip.
4. Tip insulator.
5. BNC adaptor.
6. Trimming tool.

PROBE ACCESSORIES



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ALL CROS.

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per 80" printer will enable you to print **letters, reports, graphics ed pictures,** etc and importantly for the programmer, Hard Copy of n listings.
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SELF CENTERING

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(ETI DEC '83)

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050 lines resolution at centre screen. ★ 22MHz dwidth. ★ Video input impedance switch vs networking use. ★ Incredible — repeat edible — resolution.

nteed (we mean it) to out perform any other low cost tor in Australia.

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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.

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0 Key Qwerty Computer Keyboard exactly the type as has been used up to now with the us Microbee Computer. SPST keys. Complete mounting plate, all key caps etc. Fully nbled. Incredible value — Be Quick!

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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

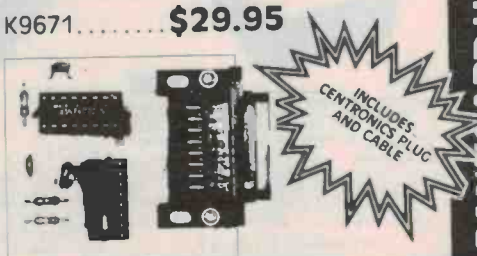
K9673 ..... **$99.50**

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**



ONE YOUR ORDER — ALTRONICS TOLL FREE 008·999·007

SHOPAROUND

ETI-659 VIC-20 audio cassette interface

All the parts for this project are quite common and you should not have any trouble finding them. Kits will be supplied by **Altronics** in Perth, **Jaycar** in Sydney and **Rod Irving Electronics** in Melbourne. **All Electronic Components** in Melbourne will also probably be stocking the kits, and possibly **Dick Smith** stores.

ETI-662B microprocessor-based timer controller, part 2

ETI-662D darkroom exposure/process timer

Most of the components for these projects are readily available. The OKI case is distributed by **Mayer Krieg, 49 Brodie Rd, Rydalmere NSW (02)684-1900,** and also of Adelaide. Try **Rod Irving Electronics** for a kit and possibly **All Electronic Components**; both are in Melbourne.

ETI-1421 preamp for paging amplifier

Components for this project are all commonly available items, with the exception of the special pots which are distributed by **Soanar Electronics. (02)789-6744.** For kits try **Jaycar** in Sydney and in Melbourne **Rod Irving Electronics** and **All Electronic Components** should have kits.

ETI-737 high performance 440/470 Mhz preamp

Dick Smith Electronics has kits and all the parts. The BFR91 transistor is distributed by **VSI Electronics (02)439-4655,** and **Nexus Electronics (02)922-1722.**

ETI-340 vehicle security alarm

This project was published last month, April 1983. We have been advised that suitable microphone sensors are available from **Technical Security Products, 102A/B May St, St Peters NSW. (02)519-6894.** They are available off the shelf in reasonable quantities at prices between $3 and $4.

New electronics shop in the ACT

Australis Electronics, Shop 3, 14 Lonsdale St, Braddon ACT 2601. (062)47-5172 bh or (062)58-1867 ah, has been in business for several months and stocks a range of Altronics components and kits along with Pearce-Simpson car sound gear and CB radios, AWA-TOA PA equipment, Sharp calculators, cordless and decorator phones, answering machines, project pc boards plus uncle Tom Cobley & all (well — something close to that, anyway). Proprietor, Geoff Robertson, is keen to please so Canberra, Queanbeyan and surrounding residents might find Australis Electronics a convenient outlet.

Boards and panels

For those wanting ready-made pc boards and/or Scotchcal panels for projects this month and last month, please refer to the list of suppliers in this column in the **March** issue.

If you're willing to go to the trouble of making your own boards and Scotchcals, then positive or negative transparencies can be obtained from ETI for the prices listed bel paid). Send your reque **Artwork Sales, PO B Waterloo NSW 2017.** state which artwork y by *project number*, and you need positives to photoresist. Make out or money orders to the Publishing Co.

April artwork

ETI-662a GP Micro $2.95.
ETI-662b Timer/Contr the two boards $ for the panel, $6.
ETI-340 Vehicle Syste for the two boar for the panel $2.5 the window sticke
ETI-1522 Room Lights ler: $6.60.

May artwork

ETI-659 VIC-20 Audio Cassette Interface: for the board $2.00, for the panel $3.00.
ETI-1421 Paging Amp Preamp: $2.40.
ETI-737 440/470 MHz UHF Preamp: $1.00!
ETI-662d Exposure/Process Timer: for the boards $6.60, and for the panels $8.45.

BARGAINS...BARGAINS...BARGAINS...BARGAINS

UNIVERSAL TEST LEAD KITS

P10190 Lead Set... $3.95

DOUBLE POWER POINT

1-9 $6.95 | 10+ $5.95 | P18030

T11302

UNIVERSAL SOLDERING IRON STAND

1-9 $4.95 | 10+ $3.95

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MN3001
(SCOOP PURCHASE FOR OUR KITS)
NORMALLY $19.95

1-9 $12.95 | 10+ $10.95

THIS MONTH
BUCKET BRIGADE IC'S
SAVE, SAVE, SAVE,
EX1 IC EXTRACTOR

DON'T DAMAGE YOUR IC'S WHEN YOU HAVE TO PULL THEM OUT. 1-9 $1.20 | 10+ .95

2K OHM MULTIMETER
11 RANGES POCKET SIZE

SPECIFICATIONS
11 RANGES
DC VOLTAGE: 0-10-50-250-1000 volts
2000 ohms/volt
AC VOLTAGE: 0-10-50-250-1000 volts
2000 ohms/volt
DECIBELS: −10 TO +22dB in four ranges
OHMETER: 0-10 k/ohms, 0-1 megaohms
DC CURRENT: 1-100mA
NORMALLY $14.95
THIS MONTH $9.95

BUTTON CELLS
FREE CHART ON WHAT THEY FIT. CHARGE YOUR FRIENDS $4.00 TO FIT THEM INCLUDING THE BATTERY FOR FIVE MINUTES WORK.

	1-9	10+
SG13/G13	1.50	1.00
SG12/12	1.20	.80
SG10/G10	1.20	.80
SG3/G3	1.20	.80
AG13/LR44	1.00	.75
AG12/LR43	.75	.60

HI WATT BATTERIES
WE JUST LANDED A TONNE OF THESE LITTLE "HEART" STARTERS TO CHEAP THAT YOU CAN THROW THEM AWAY AFTER USING THEM ONCE IF YOU WANT TO.

	1-9	10+
AA	15c	10c
C	20c	15d
D	25c	20c
9V	40c	30c

SOLDER CENTRONICS PLUGS
(UNREAL PRICE. BUT ABSOLUTE TOP QUALITY)

1-9 $6.95 | 10-99 $5.95 | 100+ $4.95

NORMALLY $14.95. (OUR OPPOSITION CHARGE UP TO $19.95. ARE YOU PAYING TOO MUCH FOR OTHER PRODUCTS FROM THEM AS WELL.)

ELECTRET MIC INSERTS
WITH PINS FOR EASY BOARD INSERTION

1-9 $1.25 | 10-99 $1.10 | 100+ $1.00

DON'T PAY TOO MUCH BREADBOARD SPECIALS

CAT. No.	No. HOLES	COMP. PRICE	OUR PRICE
P11000	100	2.95	$1.50
P11005	640	8.95	$5.95
P11009	840	14.85	$10.95
P11012	1680	27.95	$19.95
P11015	2420	45.00	$29.95

HALF HEIGHT 5" DRIVE SPECIALISTS

MITSUBISHI	BARE DRIVE	WITH BOX + P.S.
M4851 500K BYTE	$329.00	$369.00
M4853 1M BYTE	$359.00	$399.00
M4854 1.6M BYTE	$399.00	$439.00

MP 5" STANDARD DRIVES

B51	$0269.00	$299.00
B52	$349.00	$379.00
B91	$349.00	$379.00
B92	$439.00	$459.00

ALL DRIVE PRICES INCLUDE SALES TAX

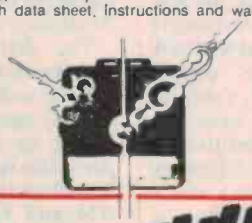
COMPUTER CABLES

QUARTZ CRYSTAL CLOCK MOVEMENT

- Very compact and reliable
- Self starting one-second stepping motor has strong torque
- Powered by 1.5V AA battery that lasts for a year
- Supplied with two sets of hands, one short and one long
- ± 15 second/month accuracy
- 56mm square, 15mm deep.

Complete with data sheet, instructions and wall hanger bracket.
Cat. XC-0100

$14.95



T03 HEATSINK

1-9 $1.00 | 10-99 90¢ | 100+ 75¢

DATA BOOKS, DATA BOOKS
YOU WILL NEED THESE FOR SCHOOL

FAIRCHILD CMOS	$9.95
NATIONAL LOGIC TTL	$9.95
NATIONAL LINEAR I	$9.50
NATIONAL LINEAR II	$9.50
NATIONAL CMOS	$9.50
NATIONAL LINEAR APPLICATIONS	$14.50

CHASIS PUNCH SET
(WE KNOCK A HOLE IN THE OPPOSITION'S PRICES ON THIS ONE) **$16.95**

JOYSTICKS

(AS USED IN YOUR STANDARD COIN OPERATED MACHINE'S. THESE SHOULD GIVE YEARS' OF SERVICE AS USED BY THE PROFESSIONAL OPERATORS.)

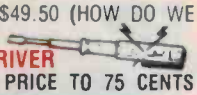
	1-9	10+
2 WAY (2 MICROSWITCHES)	21-50	18-50
4 WAY (4 MICROSWITCHES)	23-50	19-50

DIP SWITCHES 4 WAY $1.00
8 WAY $1.50

AA NICADS 1-9 1-75 | 10-99 1-60 | 100+ 1-50
NORMALLY $2.50 EACH

BARGAIN HUNTERS CORNER
(GET YOUR BIG GAME HERE)
THE STING DISK FOR MICROBEE™ 50 only in stock WAS $395.00 NOW $195.00. GET IN QUICK.

5 CP-80 RIBBONS FOR $49.50 (HOW DO WE DO IT?)



NEON TEST SCREWDRIVER
WE HAVE ZAPPED THE PRICE TO 75 CENTS

OUR NEW RANGE OF OSCILLOSCOPES is in stock

15 MHz AC-DC PORTABLE	$695.00 Including Tax
20MHz Dual Track	$495.00 Including Tax
45MHz Dual Track	$995.00 Including Tax

Probes are extra at $29.50 each

BUY IN LOTS OF 10 AND SAVE
PIC A PAK SPECIALS

10 2SJ49 for	$49.00	10 74C926 for	$59.00
10 2SK134 for	$49.00	10 2732 for	$49.00
10 2N3055 for	$7.50	10 2764 for	$79.00
10 BUX80 for	$39.00	10 74LS245	$12.00
10 BD139 for	$3.90	10 4164 for	$69.00
10 BD140 for	$3.90	10 7400 for	$2.90
10 RED LEDS 5mm	.90	10 H1044 DELUXE	
10 GREEN LEDS	$1.40	METAL CASES for	$49.50

LINE FILTERS 3 AMP 240 VAC.
$11.95

JUST ARRIVED
NEW DIGITAL MULTIMETER

PUSH BUTTON CONTROLS BUT UNDER $60.00

WOW!!!
10 AMP
1-9 59-95 | 10+ 52.50

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425 High St., Northcote, Vic. 48-50 A'Beckett St., Melb., Vic.
Phone (03) 489 8866, (03) 489 8131, Mail Order Hotline (03) 481 1436
Mail orders to P.O. Box 235 Northcote 3070 Vic.

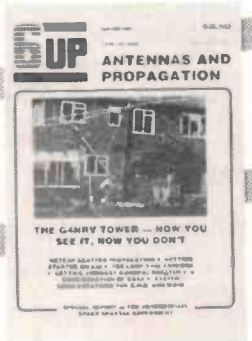
Minimum P & P $3.00. Errors & omissions excepted.
Please address tax exempt, school, wholesale and dealer enquiries

RITRONICS WHOLESALE

1st floor 425 High St. Northcote 3070 (03) 489 7099 (03) 481 1923
Telex AA 38897

FAIR MATE SW/AM/FM RECEIVER A FAIR PERFORMER

The Fair Mate AR-150 multiband receiver, just released by Dick Smith Electronics at $119 retail, has proved a better than fair performer in the short trials we ran on it over the past few weeks here at ETI.



The quarterly magazine for the VHF/UHF enthusiast. The Autumn 1984 issue is packed with articles around the theme of "Antennas and Propagation". All good solid, practical stuff — from a novel do-it-yourself tower to the art of auroral scatter, from antennas for 432 MHz to a consideration of coax; plus much more. The miserly sum of $3.50 plus 90 cents post and handling will secure the Autumn issue for you. Send to: **Teknidata, P.O. Box 844, North Sydney NSW 2060.** Subscription details will be despatched to you. Winter issue (June-July) theme: **VHF/UHF Components and Construction.**

The AR-150 covers nine bands in all — the AM broadcast band from 530-1650 kHz, the FM broadcast band from 88-108 MHz and seven shortwave bands: 5.90-6.25 MHz (49 m), 7.0-7.4 MHz (41 m), 9.45-9.85 MHz (31 m), 11.7-12.0 MHz (25 m), 15.1-15.45 MHz (19 m), 17.65-17.95 MHz (16 m) and 21.45-21.75 MHz.

This compact, portable receiver measures a mere 180 mm wide by 135 mm high by 33 mm deep and weighs just over half a kilogram. Apart from the main tuning control, the AR-150 is provided with a shortwave band selector, an FM/SW/MW band selector, tone control switch (high-cut type), a volume control and an on/off switch. A tuning LED is provided to indicate when you're correctly tuned to a station, provided it's a reasonable signal strength.

A short, fold-away whip antenna is included, along with an external antenna connection enabling a long wire or other antenna to be used to improve shortwave reception.

The AR-150 may be powered internally from four AA cells, or externally via a dc input jack (requires 6 V nominal). The 70 mm diameter internal speaker does a fair job for the 500 mW audio output, but you can plug in an earphone if you wish, for personal listening.

On the air it gave a good account of itself. Using the whip antenna, it readily pulled in the stronger shortwave stations and quite a few of the less powerful Pacific area broadcasters too. On an external antenna, it really pulls those signals in! The double-conversion design (10.7 MHz 1st IF, 455 kHz 2nd IF) obviated any "double-spotting" of stations from the image frequency response.

The bandspread tuning on shortwave made tuning a pleasure and the selectivity seemed adequate to sort out most stations in the crowded bands, even the weak ones between the 'rock crushers'.

Dynamic range seems adequate, provided you don't put too long an external antenna on it or use the receiver in a location near to local broadcast stations. Some crossmodulation can be experienced under such circumstances.

The stability seemed quite adequate for shortwave reception, although the receiver tended to drift a little in the first 20 minutes or so after turn-on.

The dial is marked every 50 kHz on the SW bands, making the search for stations reasonably easy, but you could not expect to reset the dial to a particular spot with any expectation of success. Operation on the AM and FM broadcast bands was as good as you'd expect from most transistor portables.

Overall, the Fairmate AR-150 is a better than fair performer and, at the price, would be an excellent buy for any beginner to the shortwave listening game or as a 'casual' or portable receiver for the old-hand SWL. Contact your nearest Dick Smith Electronics store for further details or an over-the-counter demonstration.

HAMS IN SPACE

A meeting was held in Houston Texas, on 9th March, to evaluate the future of amateur radio in space flight. Present at the meeting were Dr Owen Garriott, who flew on STS9 last December, and Tony Englund, who will fly in November '84.

England wants to add a 10 metre transceiver to the flight-proven two metre rig, in the hope that this will give almost world-wide communications from any point in the orbit.

Other changes being suggested include an automatic station to allow SWL reports, or possibly a completely automated facility capable of two-way QSOs.

Signal strengths may be improved if NASA grants permission to install external aerials on the shuttle.

After flight 51B in November this year, amateurs will have to wait until 51F in March '85, when it is hoped at least one of the astronauts will hold an amateur licence.

NEW SATELLITE LAUNCH

The US Military launched a new satellite for the UK University of Surry on March 1st.

The satellite, UoSAT 2, was part of a package that flew with the fourth Landsat flight, Landsat D. It was placed in polar orbit, 480 km up.

Early in the flight troubles developed with its two metre beacon caused, it is believed, by low output levels from an oscillator. The oscillator itself failed due to low temperature and on-board current limiting.

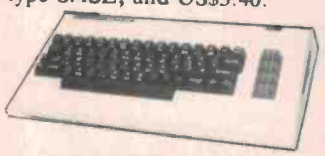
Controllers are hopeful that by turning the oscillator off and then on again they can overcome the problem.

UoSAT 2 can be heard on three frequencies at the moment: 145.08 MHz, 435.025 MHz and 2401.5 MHz. The two metre beacon has been reported by several terrestrial stations, but its level is very low.

VIC-20 RTTY

VIC-20 users may be interested in some public domain software for sending and receiving RTTY.

If you have the 8K expansion write to: **Don Shollenberger, 707 Park St, Bloomsburg, PA 17815, USA**, enclosing a sturdy mailer type SASE, and US$3.40.



'MR EDDYSTONE' HAS DIED

Readers with a sense of history may be interested to learn that a link has been severed with one of the pioneers of radio.

George Stratton Laughton died recently in England. He was one of the people who set up the Laughton Group in the early 1920s.

Among other things, the Laughton Group ran Eddystone Radio, famous for half a century as one of the most innovative builders of radio sets about.

The company was taken over in 1980 by Marconi, and the name still adorns that group's top line VHF/UHF receivers.

ELECTRONICS TOUR OF JAPAN

PAUL Rodenhuis VK2AHB, author of 'QSO JA Now', will lead a tour of Japan from September 22nd to October 6th, 1984. Paul speaks, reads and writes Japanese and has been a student of the country and its culture for more than ten years. He has often visited Japan and is well qualified to introduce you to this fascinating country and its people.

Paul will be assisted by Mrs Etsuko Howard, wife of Keith VK2AKX, who will join the tour to assist in the sightseeing and to help the ladies with their shopping. Etsuko is a Japanese National and has been a resident in Australia for ten years.

Tour highlights will include the Japan Electronics Show and Audio Fair in Tokyo, factory tours of manufacturers of consumer electronics, sightseeing in Kyoto, Hiroshima and Tokyo, Tokyo Disneyland and shopping for radios and electronic parts in Akihabara, the famous 'electronic city' in Tokyo.

Free time has been allocated in Kyoto, Hiroshima and Tokyo so you can make arrangements for an eyeball QSO with your JA friends.

The approximate cost of $1390 includes airfare, internal rail travel and accommodation on a twin share basis. Meals are not included, but Paul and Etsuko will introduce you to a wide variety of tasty, inexpensive dishes.

For more details of the tour contact **Travelaw, 7th floor, 130 Phillip St, Sydney NSW 2000. (02) 233-8442.**

NEW RECEIVERS FROM NATIONAL

National has just announced the release of their RF300 and RF B600 portable communications receivers.

Both have been designed to optimize tuning into low-strength stations under the most difficult conditions, they claim.

The model RF 300 is a double-conversion design to improve image frequency rejection and to improve selectivity and reception stability.

It also has a fast tuning selector that moves in 10 kHz steps in AM and 100 kHz steps in FM reception modes.

The RF B600 model uses microprocessors to synthesise the exact frequencies and includes a memory enabling you to 'store' the frequencies of up to nine stations.

It can also be used in a conventional rotary tuning mode, or in a scanning mode, where it will scan the nine preset frequencies in turn.

More information is obtainable from National Panasonic, **95-99 Epping Rd, North Ryde 2113 NSW. (02)887-5315.**

ON SPECIAL

FERGUSON TRANSFORMERS

PRINTED CIRCUIT BOARD MOUNTING TRANSFORMERS

PL9/5VA	$7.95	PL24/5VA	$7.95	PL18/12VA	$10.50
PL12/5VA	$7.95	PL30/5VA	$7.95	PL24/12VA	$10.50
PL15/5VA	$7.95	PL40/5VA	$7.95	PL30/12VA	$10.50
PL18/5VA	$7.95	PL161/5VA	$10.50		

LOW PROFILE CHASSIS MOUNTING TRANSFORMERS

PL12/20VA	$14.75	PL12/60VA	$19.50	PL24/40VA	$16.50
PL15/20VA	$14.75	PL15/60VA	$19.50	PL30/40VA	$16.50
PL18/20VA	$14.75	PL18/60VA	$21.50	PL40/40VA	$16.50
PL24/20VA	$14.75	PL24/60VA	$21.50	PL30-9/40VA	$23.50
PL30/20VA	$14.75	PL12/40VA	$16.50		
PL40/20VA	$14.75	PL15/40VA	$16.50	PL30/60VA	$21.50
PL1.5-18/20VA	$23.50	PL18/40VA	$16.50	PL30-9/60VA	$25.50

CONVENTIONAL CHASSIS MOUNTING TRANSFORMERS

PF3577	$33.90	PF3993	$23.90	PF4362	$57.90
PF3783	$79.50	PF4244	$46.50	PF4363	$57.90
PF3787	$21.50	PF4354	$49.50	PF4405	$44.50
PF3788	$43.50	PF4361/1	$49.50		

BELL TRANSFORMERS

PPB4/1000 $15.50 PPB8/1000 $15.50 PPB12/500 $15.50

AUDIO TRANSFORMERS

MT552	$28.50	OP590	$46.50	OP592	$36.90

D.C. POWER SUPPLIES

PPA3DC	$12.90	PPA60C	$12.90	PPA90C	$12.90
PPA4.50C	$12.90	PPA7.50C	$12.90		

BUILD YOUR OWN SPEAKERS WITH PHILIPS

Part No.	Price
ADO 1610 T8	$16.95
ADO 2160 SQ8	$49.50
AD70601 W8/620	$28.50
AD 12250 W8	$83.00

P.C. EDGE CONNECTORS

S100 gold plated wire wrap	$6.90
S100 solder tail	$5.90
D2 Motorola bus 43 86 solder tail	$8.50
43 86 gold plated wire wrap	$11.50

10 TURN POTENTIOMETERS

Stock resistance values

50R 100R 200R
500R 1K 2K 5K
10K 20K 50K
100K

Spectrol model 534 x shaft
Price 1 9 $9.50
10 + values may be mixed $8.50

DIP PLUGS

Ideal for use with flat ribbon cable or to mount components on

14 pin $1.50 24 pin $2.90
16 pin $1.90 40 pins $5

POWER TRANSFORMERS

SPECIALLY DESIGNED FOR MICROCOMPUTERS

- Good regulation electrostatic shield
- RI 810 8V @ 10A x 15V @ 1A $39.50
- RI 820 8V @ 20A 15V @ 1A 15V @ 3A $54.50

20 TURN CERMET TRIM POT

SPECTROL 43P ACTUAL SIZE

STOCK RESISTANCE VALUES
10R 20R 50R 100R 200R 500R 1K 2K 5K 10K 20K 50K 100K 200K 500K 1M 2M

1-9	10-99	100+
$1.40	$1.30	$1.00

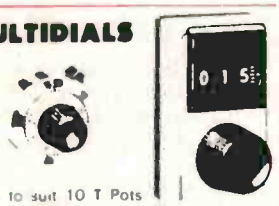
Values may be mixed.

Hexadecimal Keypad $42.50

19 key pad includes 1 10 keys A B C D E F and 2 optional keys and a shift key

Ideal for dream project

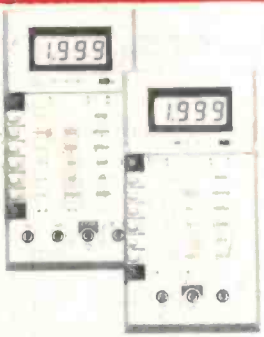
MULTIDIALS



Dials to suit 10 T Pots

Model 21 1 8" dia	$24.50
Model 16 9" dia	$19.50
Model 18 1" x 1.75" dia	$27.50

RITRON DIGITAL MULTIMETERS



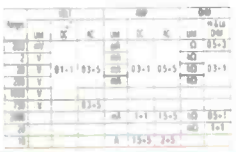
- 28 Ranges
- Push Button Operation
- Auto Polarity
- Low Battery Indicator
- Full Overload Protection
- Finger Guards on Probes and Shrouded Plugs for Safety
- Accuracy: 1 year 18°C to 28°C (+ % of reading + No. of Digits) 200 hour battery life

Q16010 specifications

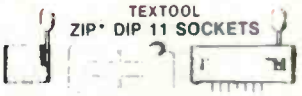
1-4	5+
$57.50	$55.00

Q17040 specifications

1-4	5+
$87.50	$83.50



TEXTOOL ZIP* DIP 11 SOCKETS



16 Pin Zip* Dip 11	$11.50
24 Pin Zip* Dip 11	12.50
40 Pin Zip* Dip 11	17.50

*Zero Insertion Pressure

DIP SWITCHES SPST

P N	No of Switches	Price
SD3	3	$1.60
SD4	4	1.70
SD5	5	1.90
SD6	6	2.30
SD7	7	2.40
SD8	8	2.50
SD9	9	2.70
SD10	10	3.00

DIP SWITCHES SPST

cermet single TURN TRIM POT

Spectrol model 63P ACTUAL SIZE

STOCK VALUES
10R 20R 50R 100R 200R 500R 1K 2K 5K 10K 20K 50K 200K 500K 1M 2M

1 9	$1.20
10 99	$1.00
100	$0.90

Values may be mixed.

HEATSINKS

High Thermal Capacity Black Anodised

	1-4	5-9	10-49	50-99	100-499	500 plus
	$	$	$	$	$	$
HS1 — 38mm	1.85	1.75	1.50	1.35	1.00	0.90
HS2 — 75mm	3.00	2.90	2.50	2.00	2.00	1.50
HS3 — 150mm	5.80	5.40	4.90	3.80	2.90	2.70
HS4 — 225mm	8.10	7.60	7.10	5.90	4.50	4.30
HS5 — 300mm	8.90	8.40	7.90	6.50	4.90	4.60

Unanodised

HS11 — 38mm	1.40	1.20	1.00	0.90	0.80	0.70
HS12 — 75mm	2.50	2.20	1.90	1.60	1.25	1.20
HS13 — 150mm	4.90	4.50	4.00	3.20	2.45	2.40

RS232 & "D" TYPE CONNECTORS

PART NO.	DESCRIPTION	½ PRICE THIS MONTH	1-9	10-25
DE 9P	9 PIN MALE		$1.75	$1.60
DE 9S	9 PIN FEMALE		2.25	2.10
DE 9C	9 PIN COVER		2.55	2.45
DA 15P	13 PIN MALE		1.10	1.05
DA 15S	15 PIN FEMALE		2.25	2.10
DA 15C	15 PIN COVER		1.15	1.05
DB 25P	25 PIN MALE		2.95	2.80
DB 25S	25 PIN FEMALE		3.45	3.30
DB 25C	1 pc Grey Hood		1.20	1.10
DB 25C2B	2 pc Black Hood		1.40	1.35
DB 25C2G	2 pc Grey Hood		1.35	1.25
DC 37P	37 PIN MALE		3.95	3.75
DC 37S	37 PIN FEMALE		5.45	4.95
DC 37C	37 PIN COVER		2.45	2.25
DH S	Hardware Set (2 Pairs)		1.05	0.95

BLANK CASSETTES T.D.K.

TDK ADC60	1 for $3.99	10 for $28.60
TDK DC60	1 for $2.30	10 for $19.99
TDK ODC60	1 for $3.85	10 for $34.10
TDK SAC60	1 for $3.85	10 for $34.10
TDK SAXC60	1 for $6.30	10 for $50.60
TDK DC90	1 for $2.60	10 for $22.10
TDK ADC 90	1 for $3.85	10 for $33.00
TDK SAC90	1 for $4.65	10 for $42.90
TDK ODC90	1 for $5.20	10 for $59.50
TDK SAXC90	1 for $5.99	10 for $59.99
TDK DC120	1 for $4.99	10 for $40.70
TDK ADC120	1 for $5.99	10 for $53.00

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Ph: (03) 489 8866 ERRORS AND OMISSIONS EXCEPTED

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425 HIGH STREET, NORTHCOTE 3070, MELBOURNE, VICTORIA. Ph (03) 489 8131 Telex No. 38897
48–50 A'BECKETT STREET, MELBOURNE (03) 347-9251

An introduction to RF test and measurement

In a communications system involving a transmitter and a receiver, there are a series of fundamental measurements and instruments that are used to characterise the performance of a system.

Roger Harrison

ANY COMMUNICATIONS system is called upon to operate in a predictable way under given circumstances. The parameters of a communications path between two points, whether they be on the Earth's surface or between a spacecraft and Earth or even between spacecraft, can be determined beforehand from electromagnetic and communications theory. Thus, the fundamental characteristics of a communications system, the transmitter and receiver (often including the antenna), to meet the requirements of those parameters can be set down.

In designing or testing transmitters and receivers, certain instruments, or tools if you like, are necessary to determine the characteristics of the system. But, before going onto the necessary tools, let's examine the fundamental characteristics of transmitters and receivers we need to know.

RECEIVER CHARACTERISTICS

The first thing you need to know about a receiver is its *sensitivity*. That is, what is the lowest level signal the receiver will detect and demodulate for a useful output. The sensitivity of a receiver is usually expressed as so many microvolts for a given *signal-plus-noise/noise* ratio (in decibels), or as a SINAD which is the *signal-plus-noise-and-distortion/noise* ratio. The latter is the more widely used. From this you can see that noise plays an important part in a communications system. Noise is the limiting factor in reception. For all but very specialised detection techniques, a signal must be above the noise to be detected. The ratio of the signal compared to the noise is simply called the *signal-to-noise* ratio. It is usually expressed in decibels.

Noise

Noise is classified into two general forms: random and non-random. (How perspicacious!). An unwanted signal that interferes with the wanted signal is classed as non-random noise. It may be gererated by a vehicle ignition system or a transmission 'overlapping' the channel to which you are tuned. Such interfering signals may be reduced or eliminated by techniques aimed at directly filtering or otherwise suppressing their detection.

Random noise is generated both inside a receiver and from external sources. Below about 25 MHz, galactic, atmospheric and man-made noise arriving at the receiver antenna is usually much greater than any noise generated inside the receiver circuitry. You'll observe this phenomena whenever you connect an external antenna to a shortwave receiver. Thus, reception below 25 MHz is ultimately limited by external noise, not the receiver.

Above 50-100 MHz, atmospheric and man-made noise decreases dramatically and the noise generated internally by a receiver becomes the limiting factor. This sort of noise is generated by the movement of electrons in any substance — resistors, transistors etc — that is operating at a temperature above absolute zero (−273°C or zero Kelvin). The electrons, moving generally in a random fashion, collide with the relatively immobile ions that make the bulk of the material. This won't produce a *net* current in any direction, but a series of random pulses of randomly varying amplitude. As the pulses are random, they produce a broad frequency spectrum and, as temperature increases, so does the noise power generated.

The noise power produced is related to the absolute temperature and the bandwidth of the system. Like this:

$$P_n = K.T.B.$$

where P_n is the noise power produced
K is Boltzmann's constant (1.374×10^{-23} joule/Kelvin)
T is absolute temperature in Kelvin
B is the system bandwidth in Hertz

You can see that the noise power is *directly* related to temperature and at 0 K, the noise power will be zero. ▶

Electronic devices such as valves, transistors, FETs etc, exhibit *noise temperatures* above their ambient temperature. That is, if you measure the noise they generate, using the above equation you'll find the temperature (T) comes out *above* ambient (which is usually around 270 K average). This noise will limit the ability of a device to respond to signals below the level of its internally generated noise. Terms such as *noise temperature, noise factor* and *noise figure* are used to characterise such device noise. The figures are given in terms of temperature (K), a ratio or in decibels, respectively.

The first stages of a receiver, the 'front end', are the most important in establishing the noise figure of a receiving system. Mathematically, it's like this:

$$F = f_1 + \frac{f_2 - 1}{G_1} + \frac{f_3 - 1}{G_1 G_1} \cdots + \frac{f_n - 1}{G_n \ldots G_{21}}$$

where F_n is noise factor of the n^{th} stage
G_n is gain of the n^{th} stage
f_1, f_2, f_3 are noise factors of stages 1,2,3
G_1, G_2 are gains of stages 1,2

It's obvious from this that the first stage largely determines the noise figure and, if the gain of this and succeeding stages is greater than one, the denominator of each term becomes greater, making successive terms smaller and smaller. Thus, little noise is contributed by stages beyond the first and second.

Dynamic range

Now it's not much use having a very sensitive receiver that can't also handle strong signals, both inside and outside the channel of interest, without collapsing. This ability to handle strong signals along with the weak is known as *dynamic range*.

The term refers specifically to the amplitude levels of multiple signals that can be accommodated during receptin. It is generally expressed as a ratio, given in decibels. Put simply, dynamic range is the decibel difference between the largest tolerable input signal (that doesn't cause audible distortion products) and the minimum detectable signal (ultimate sensitivity).

A receiver system with poor dynamic range will cause lots of problems when confronted with strong signals within the front end passband. The worst is *crossmodulation*. This occurs when a strong off-channel signal actually modulates the signal of interest. Once it occurs, there's nothing you can do! Poor dynamic range also leads to *desensitisation;* a strong off-channel signal will reduce the receiver's sensitivity. Spurious signals may be generated in the receiver's mixer(s) by strong out-of-band signals, generally referred to as intermodulation distortion (IMD) products.

Signal generator. This run-of-the-mill signal generator, the Hewlett-Packard 6854B, provides all the fundamental features required of a modern unit. It covers 10-520 MHz and +13 dBm to −130 dBm and can be either internally or externally AM or FM modulated.

TRANSMITTERS

It should be obvious that the first characteristic you need to know about a transmitter is its power output. There are a number of ways of expressing power output, depending on the modulation system employed. For example, the *carrier* power of an amplitude modulated transmitter will be quite different to the actual peak power generated at peak modulation, but they are the same in an FM transmitter. Some modulation systems will have quite different peak and average power levels. A pulse system with a large mark-to-space ratio will have quite a low average power but an enormous peak power.

Clearly, the next characteristic you need to know about is *modulation*. This must be expressed in a manner appropriate to the modulation system employed. With amplitude modulated (AM) systems it is the *percentage* modulation, with FM systems it is the *peak deviation*, usually expressed as so many kilohertz, referred to the carrier frequency. *Linearity* of the modulation system is important as you don't want unacceptable distortion introduced.

The frequency of a transmitter's carrier, and its frequency stability, are important parameters. After all, you want the transmitter to be an *accurately known* frequency for, if it's not there, you're unlikely to receiver it! It is especially important with systems which rely on synchronous detection or carrier re-insertion (such as single-sideband or independent sideband systems).

So that other spectrum users can enjoy trouble-free operation, a transmitter needs to keep *spurious emissions* to an acceptable level. Usually spurious outputs are quoted as a ratio compared to the full carrier amplitude, expressed in decibels.

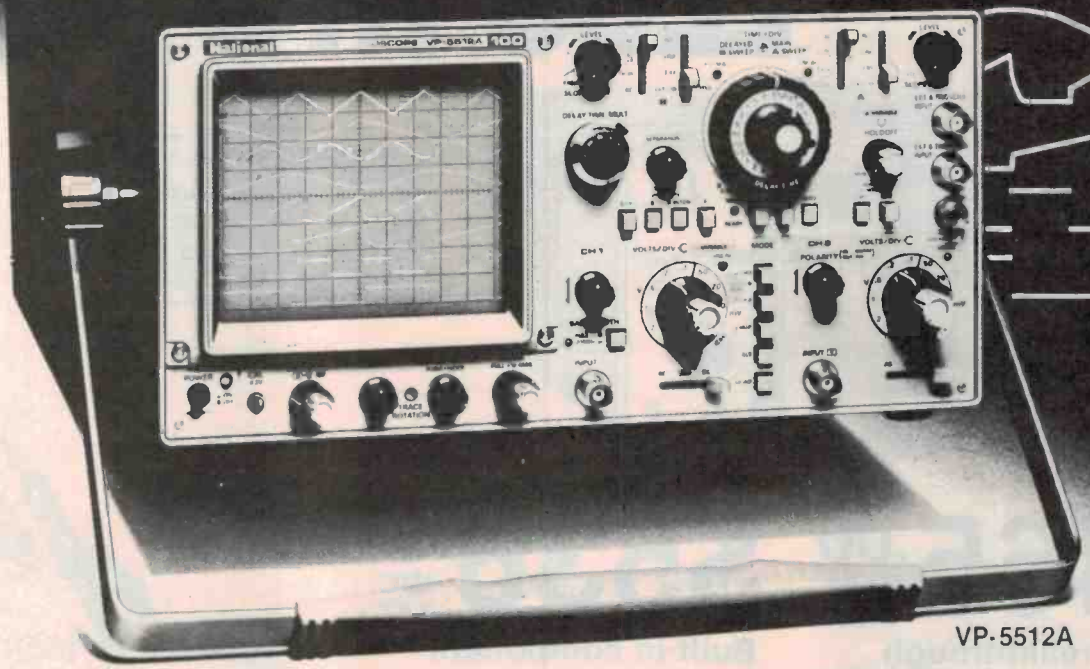
These parameters don't describe every characteristic of a transmitter or receiver, but they are the *basic* ones.

TOOLS

The signal generator

A signal generator is used to determine the sensitivity of a receiver. Two are used to determine the dynamic range. Fundamentally, a signal generator comprises a *variable oscillator*, which can be accurately set to any wanted frequency over a wide frequency range, an *attenuator*, used to set the amplitude of the oscillator's output to an accurately known level, and a *modulator* which can modulate the oscillator's output — usually providing both fre-▶

The National VP-5512A Pana Scope.



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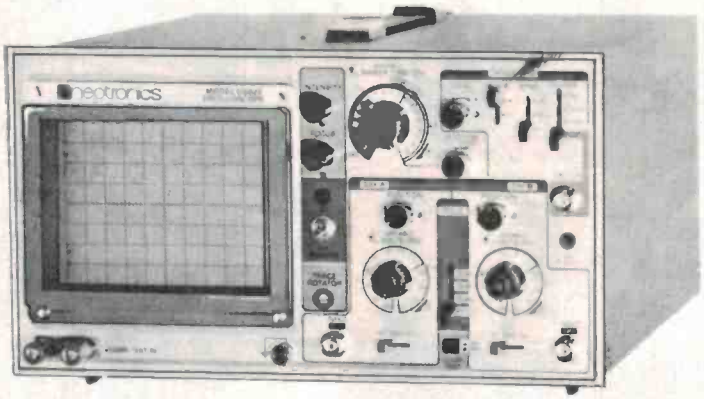

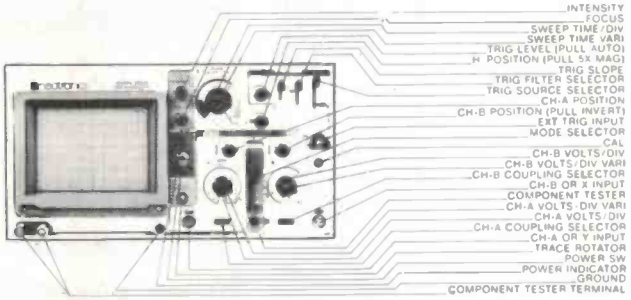

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Figure 1. The standard setup for measuring SINAD performance of a receiver.

quency and amplitude modulation.

The simplest generators generally feature a mechanical dial for frequency adjustment and readout and relatively simple attenuators and level setting controls plus a simple modulator. More sophisticated types may include: automatic amplitude levelling so that the output always remains at a constant level no matter where in its range the oscillator is set; digital frequency readout for accurate frequency setting; automatic frequency correction (AFC) to prevent oscillator drift (which would produce real problems during the course of a lengthy measurement or adjustment); a precision attenuator and calibrated modulation facilities with both internal modulation signals and external modulation inputs.

Modern receiving equipment can have sensitivities around -130 dBm (near 0.1 uV). Thus, a good signal generator must be able to produce outputs of this level.

It is often necessary to set the frequency to within 100 Hz or so, sometimes better, so accurate frequency readout is necessary or provision to couple a digital frequency meter to the oscillator should be available.

Output attenuators usually provide switched steps of 10 dB, from around 0 dBm (225 mV in 50 ohms), or as much as +20 dBm, down to -120 or −130 dBm, with levels variable over the range between the steps.

In measuring the sensitivity of a receiver, the signal generator is modulated with a standard frequency signal (usually 1 kHz) at a standard modulation ratio. The least signal generator output level then required to produce a *standard* signal + noise (& distortion)/noise ratio (SINAD) gives the receiver sensitivity. For AM systems, a 12 dB SINAD ratio is almost universally used as this represents about the minimum for a usable signal.

Noise & distortion meters

In measuring the sensitivity of a receiver, a noise and distortion meter is required. This is attached to the receiver's output while the modulated signal generator is attached to the receiver's antenna input.

The noise and distortion (N & D) meter incorporates a meter, a level adjustment (to set a reference level) and a 'notch' filter to remove the demodulated tone, leaving the noise and distortion products present at the receiver's output to be measured.

To measure the SINAD ratio, the receiver RF gain is set at maximum and the volume control adjusted to deliver the receiver's rated audio output power. The N & D meter's level control is set so the meter needle sits at a reference point on the scale and the unit set to read distortion. This switches in the notch filter which is adjusted to 'null out' the demodulated tone. The signal generator output is then adjusted to obtain a distortion meter reading 25% (12 dB) less than the reference reading. The level given by the signal generator's attenuator (usually in microvolts) is then the "12 dB SINAD sensitivity" of the receiver.

Automatic SINAD meters are available which provide the 1 kHz modulation tone for the signal generator and automatic nulling of the demodulated tone, reducing the amount of knob twiddling necessary.

Noise generators

A noise generator is used to determine the noise figure or noise factor of a receiver. Such a unit consists of a current-controlled noise source, which may be a thermionic diode — generally useful over the 30 MHz to 1 GHz range, or a gas discharge tube,

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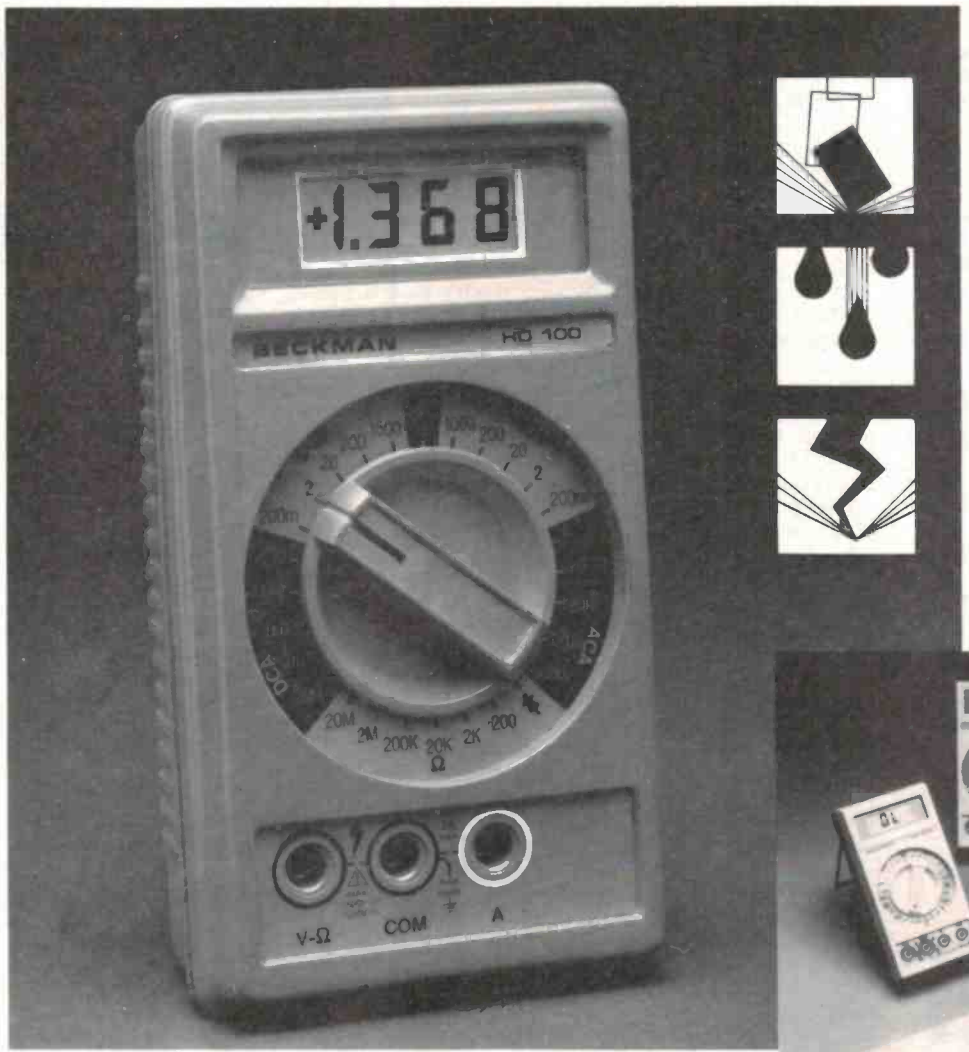

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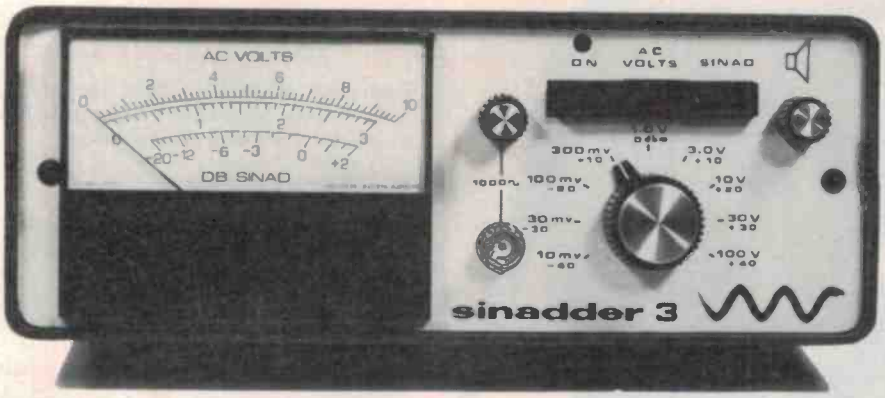


SINAD meter. This automatic SINAD meter, the Sinadder 3 from Vicom International, simplifies receiver sensitivity measurements by reducing knob-twiddling.

useful from around 500 MHz right through the microwave spectrum. They generate an accurately known level of random noise with a constant amplitude spectrum over their useful frequency range. In the case of the diode noise generator, the output is directly proportional to dc current through it. Mathematically:

$$NF(dB) = 101og_{10}20\ I.R$$

where I is the diode current in amps
R is the terminating resistance in ohms
NF is the noise figure in dB

The noise generator is coupled directly to the receiver antenna input and an ac voltmeter connected to the receiver audio output. The audio output (with RF gain at max.) is first read with the noise generator off, then the noise generator is turned on and the diode current adjusted until the receiver output is *double* the original reading. The value of the diode current at this level, when plugged into the above formula, will indicate the noise figure of the receiver.

Power meters

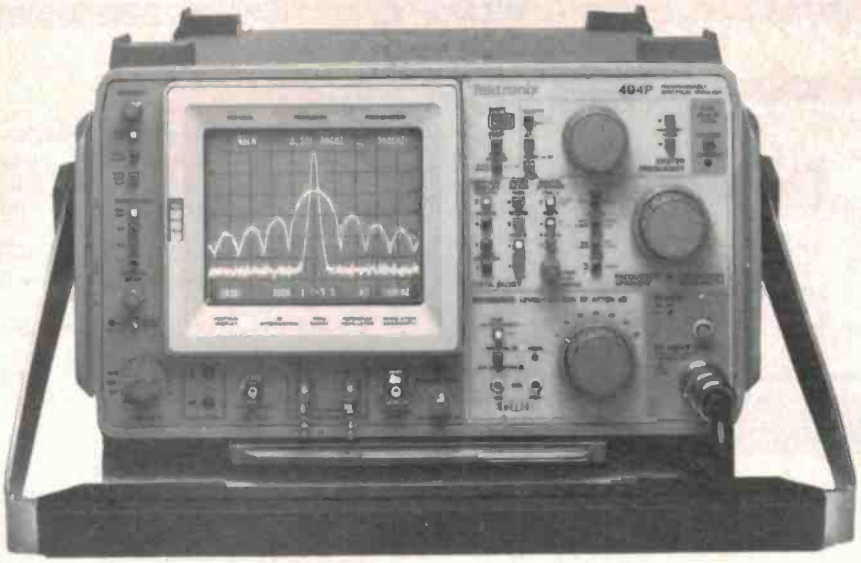
Power meters for measuring transmitter power output are of two basic types: in-line or terminating. The in-line type employs a *directional coupler* to 'pick off' a fixed proportion of the power being delivered to the load. As the coupling ratio is known, the power level coupled off in this way is directly proportional to the transmitter's output power.

Terminating power meters comprise a 'dummy' load resistance (usually 50 ohms) of appropriate power rating and a rectifying system which allows measurement of the voltage produced across the load. The power is then given by V^2/R (with due regard to peak and RMS values).

In microwave systems, the heating effect on a thermoelectric junction, called a bolometer, is employed to measure power.

To measure the modulation characteristics of a transmitter, a *modulation meter* is employed. This is a fairly basic receiver/demodulator that provides a read-out of the relevant quantities. In AM systems the modulation percentage is obtained by measuring the peak positive carrier amplitude (and/or the peak negative carrier amplitude) and comparing this to the unmodulated carrier amplitude. The ratio is expressed as a percentage. ie:

$$\%\ \text{modulation} = \frac{E_{peak} - E_{carrier}}{E_{carrier}} \times 100$$



Spectrum analyser. Probably one of the most important 'tools' in RF test measurement with a wide variety of applications. This model, from Tektronix, covers 50 kHz to 220 MHz and features digital display of the parameters on-screen.

In FM systems, frequency 'swing', or deviation, may be required or percentage modulation. Here a 'receiver' system is used which measures the variation of carrier frequency with modulation, at a standard modulation, at a standard modulating frequency, is employed. The percentage modulation is then a measure of the actual deviation compared to peak deviation.

The spectrum analyser

This device is a receiver and display system that continually 'sweeps' the receiver over a band of frequencies and displays the received signals' amplitude on an amplitude-frequency oscilloscope display. With such a unit you can 'see' what's happening over a chosen spectrum range. Among its many applications (too great to go into here) the instrument is used to check the spurious outputs from transmitters and can be used to check modulation characteristics.

Further reading

Electronic Engineer's Reference Book, 4th Edition, Edited by L. W. Turner, published by Newnes-Butterworth. ISBN 0 408 00168 2. In particular, see chapter 15 — *Telecommunications*.

Radio Transmitters, Gray and Graham, published by McGraw-Hill. Library of Congress Catalog Card Number 60-8834. In particular, see chapter 13 *Transmitter Measurement Techniques*.

The Radio Amateur's Handbook, 1984 edition, published by the American Radio Relay League (ARRL). ISBN 0 87259 161 1. In particular, see chapters 8 *(Receiving Systems)*, 9 *(VHF & UHF Receiving Techniques)* and 16 *Test Equipment and Measurements)*.

The Radio Experimenter's Handbook, Volume 1, Edited by Roger Harrison, published by the Federal Publishing Co ISBN 0 86405 014 3. In particular, see *Measuring Receiver Performance by the SINAD Method*.

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This book comprises a project divided into sections for builder to individually construct and test — then assemble into complete instrument. Includes short section on scope usage.

electronic music and audio/video

ELECTRONIC MUSIC CIRCUITS
G0126P **$26.95**
How to build a custom electronic music synthesiser, outlines numerous other circuit designs and then shows you how to modify them to achieve particular responses. Many of the circuits can be used as special-effects boxes for guitars and other musical instruments.

SOUND-SYSTEM ENGINEERING
G0129P **$35.50**
Dealing with audio systems as a whole, it includes installing and equalising the sound system and interfacing the electrical and acoustic systems, instrumentation, the acoustic environment and designing for acoustic gain.

HOW TO BUILD SPEAKER ENCLOSURES
G0131P **$9.50**
A guide to the 'whys' and 'hows' of constructing top-performance loudspeaker enclosures.

VIDEO TAPE RECORDERS
G0132P **$21.25**
In this completely revised second edition, the author tells in simple language how helical VTRs work and how to operate and service them. Includes numerous examples of circuits and mechanical systems.

AUDIO IC OP-AMP APPLICATIONS
G0138P **$15.25**
This book discusses IC op-amps and their application in audio systems, and describes the numerous advantages of using op-amps, including low power consumption, reliable performance and low cost. Assumes a basic understanding of op-amp theory.

THE COMPLETE GUIDE TO HIGH FIDELITY
G0305P **$23.75**
Includes explanations of digital recording, amplifiers, tuners, drive motors, preamplifiers, proximity effect and impedance matching. Thirty basic systems, for limited to unlimited budgets, are also discussed.

SON OF CHEAP VIDEO
G0345P **$17.95**
Don Lancaster's sequel to *The Cheap Video Cookbook* (ETI Book Sales No. G0123P) includes new and improved circuits to get alphanumeric and graphics video out of a microcomputer and on to an ordinary television.

PRACTICAL TRANSISTORISED NOVELTIES FOR HI-FI ENTHUSIASTS
G0382B **$2.95**
Includes quadrophony, stereo headphone adaptor, phasing stereo loudspeaker systems, high impedance four-channel mixer and speaker gain control. Limited supplies.

AUDIO ENTHUSIAST'S HANDBOOK
G0383B **$2.75**
Includes the record/playback curve, stylus compliance, acoustic feedback, stereo tape track standards, compensating sideways drag and amplifier power ratings.

CHOOSING AND USING YOUR HI-FI
G0385B **$4.95**
Provides basic information on the technical specifications of hi-fi equipment. Offers advice on what to look for in equipment in order to obtain real high-fidelity sound and reproduction.

computers for beginners

BEGINNING BASIC
H0146A **$24.95**
Intended for beginners with no computing experience, one should be able to intelligently program in BASIC in a short time.

PEANUT BUTTER AND JELLY GUIDE TO COMPUTERS
H0150A **$16.75**
A simple, easy-to-digest source of information on personal computing for the potential buyer who is less than an expert in the field.

INTRODUCTION TO WORD-PROCESSING
H0151A **$17.95**
Written for the non-technical reader, this book tells about the concepts common to all word-processing systems, then analyses all features.

HART'S DICTIONARY OF BASIC
H0276J **$15.75**
Contains more than 800 entries which summarise the actions of almost every statement, command or function you are ever likely to meet. Each entry is explained in plain English, not computerese.

KIDS AND THE APPLE
H0300P **$25.75**
How to write programs for the Apple computer, including action games, board games and word games.

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Z80 MICROCOMPUTER DESIGN PROJECTS
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A complete look at the internal architecture of the Z80, the heart of many microcomputers, and even shows how to build a microcomputer, the EX80, using this powerful chip.

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Presents basic microprocessor concepts in simple language for beginners and teaches you to construct a useful microcontroller system. Offers 30 demo circuits which take you through assembly, operation and programming of a microcontroller.

THE S100 AND OTHER MICRO BUSES
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The key to successful computer expansion is a complete understanding of the bus system, through which the computer communicates with peripherals. This book will give you that understanding.

MICROCOMPUTER DESIGN AND TROUBLESHOOTING
J0161P **$26.75**
Tells you how to design microcomputer systems and make them work without an expensive commercial development system or the need for costly test instrumentation. Includes a complete description of two microprocessors — the 8085 and the 6502.

PRACTICAL COMPUTER EXPERIMENTS
J0172B **$5.95**
How to build typical computer circuits using discrete logic. Useful intro to devices such as adders and storers as well as a general source book of logic circuits.

IBM PERSONAL COMPUTER — AN INTRODUCTION TO PROGRAMMING AND APPLICATIONS
J0360P **$21.95**
Designed for beginners, this book offers an informal introduction to programming in BASIC. Also covers applications for business, graphics, games and word processing and includes comprehensive tables and charts.

Z8000 HANDBOOK
J0341P **$18.95**
Provides a complete and clear description of the function and operation of the Z8001 and Z8002 16-bit microprocessors. Includes information on data types, memory management, interfacing and peripheral devices and the Z8000 instruction set.

THE ART OF PROGRAMMING THE ZX SPECTRUM
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PROTOCOLS AND TECHNIQUES FOR DATA COMMUNICATION NETWORKS
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Coverage includes the packet-switching concept, file transfer, coding for reliable data transmission, network security, remote job entry, routing and flow control techniques for packet-switched computer networks and end-to-end communications between network users.

COMPUTERS AND PROGRAMMING GUIDE FOR SCIENTISTS AND ENGINEERS
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Includes simple input/output techniques, logical operations, branches and loops, register-shift instructions, subroutines, data bus, and control signals. Limited supplies.

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computing software

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BASIC FOR EVERYONE
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FIFTY BASIC EXERCISES
K0188A **$17.95**
Designed to teach BASIC through actual practice, this book contains graduated exercises in math, business, operations research, games and statistics. The programs were designed to run directly on a TRS-80 but will run on any system with MicroSoft BASIC.

INSIDE BASIC GAMES
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The medium of games teaches readers how to design error-free, interactive BASIC programs. Rules, algorithms and coding differences for the PET, Apple II and TRS-80 are also included.

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K0193P **$6.95**
Assumes no previous knowledge of program writing. It covers the fundamentals of the Fortran language, enables extensive program writing and concentrates on programming style.

THE UCSD PASCAL HANDBOOK
K0197P **$23.75**
Language descriptions organised in a quick and easy reference are given in this book for readers with no prior experience of Pascal programming.

PASCAL
K0199A **$21.95**
For people with little or no programming experience, this book gives lots of examples that clearly explain proper usage of language features. Discusses top-down programming, debugging, self-documentation, etc.

TRS-80 COLOUR COMPUTER GRAPHICS
K0201P **$21.95**
Explore the creative and imaginative blending of computers and colour. Shows how to create dynamic and interesting graphics to enhance your programs.

ENHANCING YOUR APPLE II
K0206P **$27.95**
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TRS-80 — MORE THAN BASIC
K0207P **$15.95**
Learn to program in Z80 mnemonics by using the book's error-tolerant interactive monitor program. More than 26 commands available, with documentation that helps you change commands to meet specific applications.

TRS-80 ASSEMBLY-LANGUAGE MADE SIMPLE
K0208P **$19.25**
If you have an understanding of BASIC programming, this will help you to plan, write and hand-assemble your own assembly-language programs in memory, using the T-bug and Level II BASIC ROM subroutines.

PROGRAMMING THE TRS-80 POCKET COMPUTER
K0209P **$13.25**
This book explains all aspects of problem-solving in BASIC, and covers cassette machine interfacing and how to make the best use of the keyboard and display.

TRS-80 ASSEMBLY-LANGUAGE SUBROUTINES
K0210P **$24.95**
A wide spectrum of applications is discussed in this book, which provides easy-to-use routines that can be used as they stand or modified.

THE ART OF PROGRAMMING THE 16K ZX81
K0213B **$8.75**
A sequel to *The Art of Programming the 1K ZX81* (ETI Book Sales No K0226B), this book sets out to help you use your 16K RAM pack and ZX printer to the full. It conentrates on good programming style and introduces some interesting programs that are both fun and useful.

32 BASIC PROGRAMS FOR THE TRS-80 COMPUTER
K0211A **$29.50**
Programs for the TRS-80 Level II or Model III BASIC (with 16K or more user memory).

APPLE BASIC
K0212P **$19.25**
This book gives the beginner a thorough introduction to BASIC programming on an Apple computer, and covers all areas of programming, including graphics, mathematical programs, games and a great deal more.

APPLESOFT LANGUAGE
K0214P **$21.95**
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K0215P **$21.95**
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APPLE PASCAL GAMES
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Explore all the essential elements of UCSD Pascal and learn the important Apple Pascal extensions.

PASCAL PROGRAMMING FOR THE APPLE
K0217P **$20.25**
Teaches UCSD Pascal on the Apple II. Many examples, programs for financial applications, graphics, file structures and sound reproduction are supplied.

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K0220P **$19.25**
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BASIC PROGRAMMING PRIMER
K0223P **$27.95**
Invaluable aid to anyone who wants to learn BASIC. Covers 16-bit BASIC statements, key words and commands, with self-tests and answers plus non-numeric program example. Compatible with IBM BASIC, but applicable to any computer that runs MicroSoft BASIC.

ATARI GAMES AND RECREATIONS
K0224P **$22.25**
Beginners and advanced users can use the preprogrammed games in this book to improve their skill. Charts, flash cards, an error dictionary and graph paper designs are among the features.

THE ART OF PROGRAMMING THE 1K ZX81
K0226B **$6.75**
This book explains how to use the features of the ZX81 including its random number generator, graphics and timer. PEEK and POKE are explained and you should learn enough to develop programs of your own.

PROGRAMMING THE 6502
K0227A **$22.95**
Principles of assembly-language programming for the 6502 microprocessor are taught in this introductory text. Includes a discussion of trade-offs between hardware and software and detailed explanations of the 6502's internal registers and buss operation. Third edition.

6502 APPLICATIONS BOOK
K0228A **$20.95**
Use this book and a few low-cost components to build a complete home alarm system, an electric piano, a motor speed-regulator, a time-of-day clock, a simulated traffic control system and a Morse code generator, etc.

6502 GAMES
K0229A **$17.95**
You learn how to play 10 sophisticated games and also learn assembly language programming. Also learn the techniques of algorithm design and data structures.

START WITH BASIC ON COMMODORE VIC-20
K0233P **$14.75**
Helpful exercises and step-by-step instructions show you how to program in BASIC utilising all the graphic functions on the VIC-20. ▶

computing for business

BASIC FOR ACCOUNTANTS
L0234P **$11.95**
Shows accountancy students and accountants how to use a computer to perform the repetitive tasks associated with record keeping, calculating and report writing. Using the BASIC language attention is concentrated on debtors, inventory and general ledger systems.

COMPUTER-BASED BUSINESS SYSTEMS
L0235P **$10.95**
A short introduction to the sorts of systems used by a typical business to handle its typical activities. The book aims at providing a general understanding, and, therefore, avoids technological detail.

SMALL COMPUTERS FOR THE SMALL BUSINESSMAN
L0240A **$27.95**
How and where to shop for a computer successfully; what to expect their computer to do for them; how to select software; whether or not to use a consultant; how to introduce the computer to the staff and how much computer is necessary.

INVENTORY MANAGEMENT FOR SMALL COMPUTERS
L0241A **$27.95**
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BASIC BUSINESS SOFTWARE
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A basic insight into how business software is designed. Aimed at the small-business operator.

FROM THE COUNTER TO THE BOTTOM LINE
L0243A **$24.95**
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Guides the user step by step through all aspects of planning, evaluating and installing stages. Lively vignettes illustrate how automation increases productivity in word and data processing, electronic mail, photocomposition, telecommunications, scheduling and message switching. Probably the most comprehensive guide of its kind for every manager seeking to maximise productivity and profitability.

MICROCOMPUTERS FOR BUSINESS APPLICATIONS
L0301P **$12.95**
An invaluable aid for the potential buyer of a business microcomputer system. Limited supplies.

THE POWER OF VISICALC
L0316P **$13.35**
Exercises designed especially for users of the VisiCalc program.

MICROCOMPUTER DATA-BASE MANAGEMENT
L0322P **$16.75**
Information on file handling, sorting, searching, linking, hashing, accessing data from BASIC and data files, to help tap the full potential of the microcomputer.

THE POWER OF SUPERCALC
L0329P **$21.35**
Step-by-step exercises designed especially for users of SuperCalc.

THE POWER OF VISICALC: REAL ESTATE
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Step-by-step applications designed especially for realtors, commercial brokers, developers, contractors and property owners and managers using VisiCalc. Limited supplies.

THE VISICALC BOOK — ATARI EDITION
L0398P **$20.95**
An invaluable aid for those using VisiCalc on the Atari. How to enter data, solve problems about profit/loss projections, pricing/costing estimates, etc.

SIMPLE BASIC PROGRAMS FOR BUSINESS APPLICATIONS
L0358P **$23.50**
Program listings and sample outputs for more than 50 applications, a primer on BASIC programming, BASIC compounds and statements for popular microcomputers and BASIC-FORTRAN conversion tables.

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Directed specifically at intending developers of small computer-based business systems who are not data-processing professionals.

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L0372E **$4.25**
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A manager's guide to effective planning, implementation and evaluation of automation alternatives.

UNDERSTANDING AND BUYING A SMALL-BUSINESS COMPUTER
L0388P **$13.95**
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SMALL-BUSINESS COMPUTERS: A GUIDE TO EVALUATION AND SELECTION
L0397P **$39.95**
A guide for business and home computer buyers. Includes advice on various systems and how to ensure successful installation.

electronic calculators

ELECTRONIC CALCULATOR USER'S HANDBOOK
M0245B **$5.50**
Presents formulae, data, methods of calculation, conversion factors, etc, for use with the simplest of most sophisticated calculators. Includes the way to calculate using only a simple four-function calculator, trigonometric function, hyperbolic functions, logarithms, square roots and powers.

YOUR ELECTRONIC CALCULATOR AND YOUR MONEY
M0246B **$4.75**
Starts with a basic revision of percentages and decimals, then deals with mortgages, cars, insurance, fuel, shopping, tax, etc. There's a section on investment and one on the calculator in a small business.

TAKE A CHANCE WITH YOUR CALCULATOR
M0248A **$14.95**
An introduction to modern mathematics, this book deals with programming of programmable calculators and includes probability problems. Limited supplies.

FUN AND GAMES WITH YOUR ELECTRONIC CALCULATOR
M0370B **$2.50**
A collection of 101 jokes and riddles, several mind-boggling games for two or more players, and a dictionary of words with their corresponding numbers.

amateur radio, dx communications

COMPUTERS AND THE RADIO AMATEUR
N0249P **$31.25**
For the radio operator who wants to know how computers function and how they can be used with other equipment.

HOW TO BUILD ADVANCED SHORTWAVE RECEIVERS
N0340B **$6.95**
Contains full practical construction details of a number of receivers.

RADIO STATIONS GUIDE
N0252B **$5.95**
An aid for all those who have a radio receiver. Shows the station site, country, frequency and/or wavelength, as well as Effective Radiation Power of the transmitter and, in some cases, the station's call sign as well.

AN INTRODUCTION TO RADIO DXING
N0253B **$6.75**
One section is devoted to amateur brand reception and the other section covers broadcast band reception, with advice on suitable equipment and the techniques employed when using that equipment. The construction of a number of useful accessories is described.

TELEMATIC SOCIETY
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Demonstrates how developments in telecommunications will affect the way we live.

25 SIMPLE AMATEUR BAND AERIALS
N0286B **$6.95**
How to build 25 amateur-band aerials that are simple and inexpensive to construct and perform well. From the simple dipole up to a mini-rhombic.

THE BASIC BOOK OF HAM RADIO
N0287R **$5.75**
A comprehensive guide to the world of amateur radio.

SOLID-STATE BASICS FOR THE RADIO AMATEUR
N0290R **$5.95**
Thorough treatment of the use of solid-state devices. Provides a wealth of tried and proven circuitry, plus practical application data.

FIBER OPTICS
N0295P **$31.75**
Gives the electronics technician a practical foundation for the challenge of fibre optics. No prior knowledge of optics is necessary.

FIBER OPTICS: COMMUNICATIONS, EXPERIMENTS AND PROJECTS
N0296P **$24.35**
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AMATEUR RADIO MAP OF THE WORLD
N0362R **$4.95**
Published by the American Radio Relay League, this giant wall map is fully indexed.

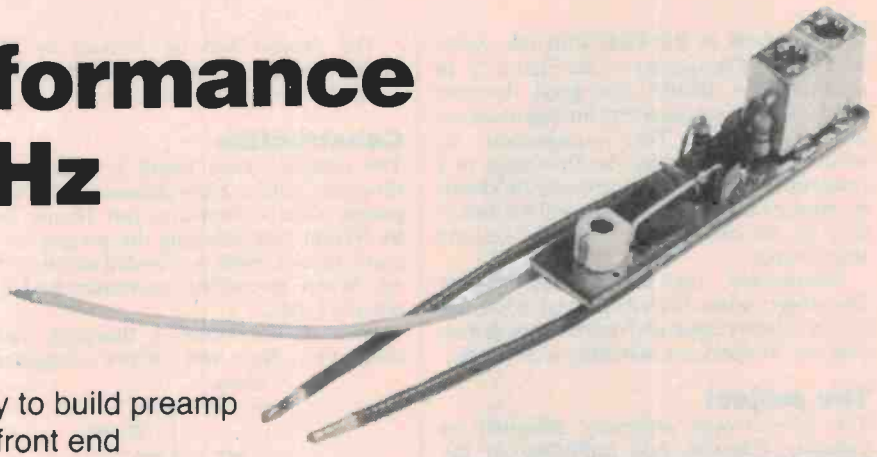
LONG-DISTANCE TELEVISION RECEPTION (TV-DX)
N0250B **$6.95**
Written by the British authority, the book includes many units and devices made by active enthusiasts. A practical and authoritative introduction to this unusual aspect of electronics.

RADIO EXPERIMENTER'S HANDBOOK Vol. 1
N0418E **$7.95**
This 132 page book from E.T.I. is chock-full of circuits, projects to build, antennas to erect, hints and tips. It covers the field from DX listening to building radioteletype gear, from 'twilight zone' DX to VHF power amplifiers, from building a radio FAX picture decoder to designing loaded and trap dipoles. Edited by Roger Harrison, VK2ZTB, it carries a wealth of practical, down-to-earth information useful to anyone interested in the art and science of radio.

THE WORLD IN MY EARS
N0420C **$9.95**
This book would represent the 'basic manual' for anyone interested, or active in, shortwave listening. Written by world-renowned authority and broadcaster, Arthur Cushen, M.B.E., the book is divided into two parts. The first covers the historical development of shortwave broadcasting and the listening hobby that grew up with it. Mr Cushen describes his own involvement with a wealth of personal anecdotes that raises it above the dry historical discourse. The second part covers the practical aspects: how to start out, how to erect antennas, all about time and time zones, DX clubs, reporting, news sessions, etc. Apart from having all the information you need to get started and to help you along, the book makes fascinating reading.

All prices of publications in this catalogue listing are subject to change without notice.

A high performance 440/470 MHz preamp



This simple, yet effective and easy to build preamp will soup-up that 'soggy' receiver front end without costing you an arm and a leg.

Roger Harrison VK2ZTB

TO GET THE BEST out of a UHF receiver system you need to pay attention to two important factors: front end noise figure and antenna feedline loss. Secondarily, you need to worry about dynamic range and intermodulation distortion. The problem of feedline loss is tackled by buying the best low-loss coax you can afford and/or keeping the feedline length between the antenna and receiver front end to a minimum. The problem of front end noise figure has to be tackled right at the front end, at the first RF stage. Much commercially available amateur UHF band equipment, and doubtless, plenty of homebrew gear too, has receiver noise figures around 4 dB to 5 dB. This is particularly true of older equipment.

While the majority of amateur contacts do not involve particularly weak signals, unless troposcatter DX is your 'bag', there are plenty of occasions when copying a weak signal is important (the aforesaid DX being one). On singlesideband or CW, a few dB *extra* signal-to-noise ratio can mean the difference between a contact and no contact in weak signal work; on FM it can mean the difference between a noisy, difficult to copy signal and full-quieting Q5. Hence, lowering your front-end noise figure from 4-5 dB to around 2 dB can make a world of difference.

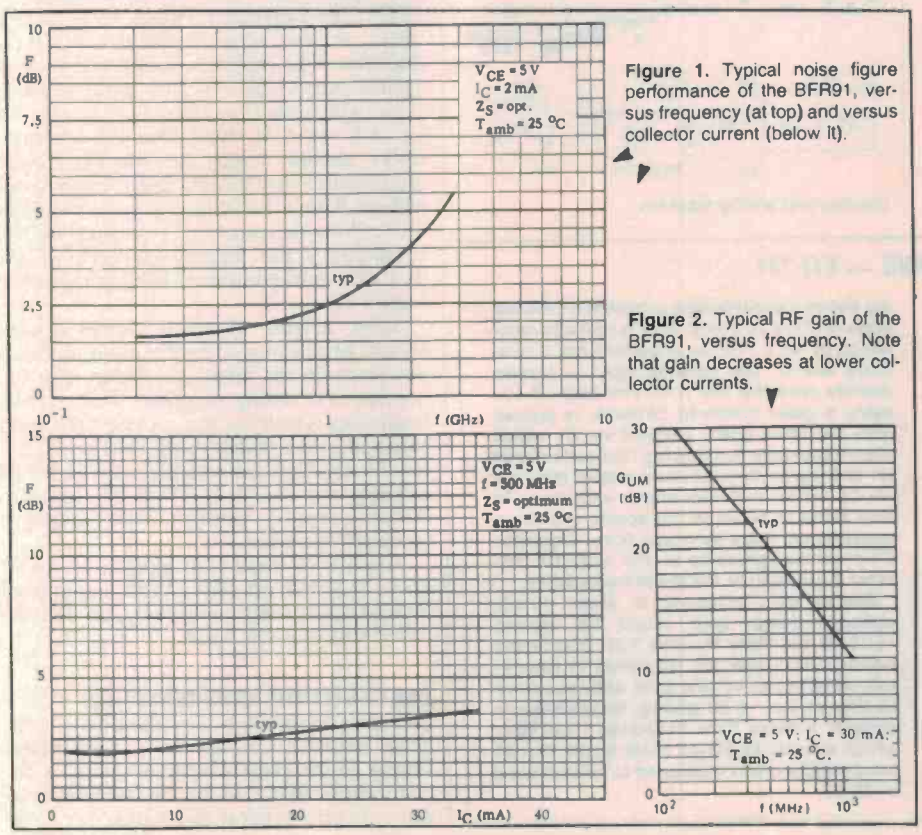


Figure 1. Typical noise figure performance of the BFR91, versus frequency (at top) and versus collector current (below it).

Figure 2. Typical RF gain of the BFR91, versus frequency. Note that gain decreases at lower collector currents.

Bipolar, or go for the GaAs?

Twenty years ago, the state of the art front end either involved a varactor parametric amplifier (a rarity) or a special low noise 'lighthouse' tube like the 416B. The parametric amp could achieve vanishingly low noise figures at 430 MHz but required a high power 'pump' oscillator, and keeping it stable was tantamount to magic (requiring five arms)! The low noise tube cost an arm and a leg, required many watts of heater power and fan cooling as a result. The parametric amp could achieve noise figures around 1-2 dB, the 416B amp "better than 3 dB" when front end noise figures of 6-10 dB were common.

These days, a state-of-the-art noise figure would be less than 1 dB, readily achieved with solid-state devices, in particular, with gallium arsenide field effect transistors (GaAs FETs). Notwithstanding such fine performance, bipolar devices can achieve similar results. But, there's a catch — you have to pay handsomely for such superlative performance. GaAs FETs have one disadvantage bipolar devices do not: they are prone to electrostatic damage (ESD). For these reasons, this project uses a relatively low cost bipolar device, a BFR91.

The BFR91

While state of the art performance can be a desirable goal, it can represent overkill in many situations. As this project is primarily aimed at *improving* the performance of an existing receiver, but not at the expense of creating difficulties for the constructor/operator, a number of subtle design factors need to be considered. Cost is one. If a preamp is going to cost, say, half what the gear is worth, for the sake of a 1 dB noise figure then justifying that cost is difficult, unless you're into moonbounce. Making a worthwhile performance improvement for $20 is much more attractive.

The BFR91 is a relatively low cost device yet exhibits good noise figure performance in the 70 cm band, achieving better than 2 dB when biased and matched correctly (Figure 1). Maximum gain is quoted at ▶

around 18 dB at 500 MHz (but this varies with bias and frequency — see Figure 2). In addition, the BFR91 has good dynamic range, achieving excellent intermodulation distortion figures. This is important, as, with this preamp being the first stage in a receiver, any distortion products produced by strong off-channel signals will be amplified by the rest of the receiver, causing interference.

Fortuitively, the BFR91 has another advantage: when biased for best noise figure, it exhibits input and output impedances close to 50 ohms, so matching is a 'snack'.

The project

The project was originally designed by Timothy Edwards and published in the March 1982 issue of the British magazine Radio and Electronics World. Gary Crapp VK2YBX, Service Manager at Dick Smith Electronics, had successfully constructed a number following the original article and approached ETI about republishing the project. Permission was duly obtained from R. & E. W. and Gary passed on a prototype for us to play with.

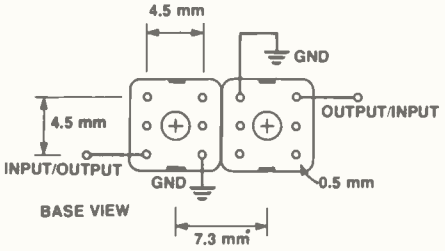
The design employs the BFR91 in grounded emitter. (See circuit figure 3). The input filter is a simple tuned single wire transmission line above a groundplane (pc board). The collector is shunt-fed and the output passes via a pair of coupled helical resonators. This pre-tuned filter is made by Toko and results in a compact, low loss filter with a bandwidth of around 20 MHz at the −3 dB points. It essentially determines the overall bandpass and out-of-band rejection for the complete amplifier. It is stocked by Dick Smith Electronics and is a new listing in their 1984 catalogue; L-1850 for the 440 MHz version, L-1860 for the 470 MHz version. Simply using the L-1860 rather than the L-1850 puts the preamp on 470 MHz, making it useful for UHF CB band applications.

The project will be stocked by Dick Smith Stores, listed as catalogue No. K-6306.

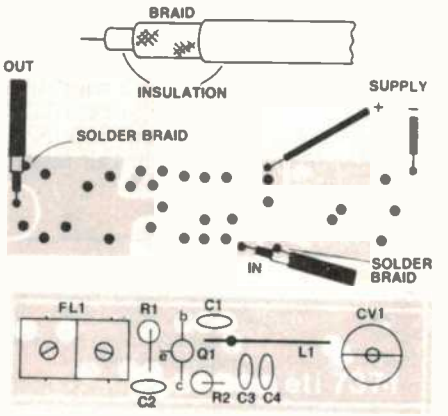
Construction

The printed circuit board is double-sided fibreglass with a groundplane on the component side. It measures just 10 mm wide by 50 mm long allowing the preamp to be easily tucked inside a crowded mobile UHF rig. When assembled, maximum height is about 17 mm.

Give the pc board a thorough visual check first. Note that, where components pass through the groundplane but do not connect to it, the copper has been etched away around the hole, providing 1-2 mm clearance. Check that all holes are correctly drilled. On the reverse side, check that there are no fine 'bridges' between the copper 'lands' on the board.



Filter pinout. Pin connections and layout of the Toko helical filter set.



Overlay and wiring diagram.

Going from the overlay, fit the BFR91 first. Bend the legs straight *down* from the body. The emitter (middle) lead should be soldered to both the *top* and *bottom* sides of the board. Next fit the helical filter set. Orientation is unimportant but the four *can* tags should be soldered to *both the top and bottom* of the pc board.

Make up the input tuned line next. Bend up a piece of 22 gauge tinned copper wire, using the holes in the pc board as a guide. Then, insert the two ends in the board and push the wire down so that it stands 4 mm from the top surface of the pc board and solder it in place. See Figure 4. Solder a short length of wire in place for the 'tap' connection (to the antenna and BFR91 base).

The rest of the components can now be mounted and soldered in place. Make sure they are all well-seated down on the board to minimise lead inductance. Note that the two resistors are mounted upright.

I should make a note here in passing about the resistors and capacitors. It is important that low inductance types be used, otherwise you're likely to experience some strange results. Most modern low-to-medium value carbon film and metal film resistors rated at ½W or less have relatively low inductance and self-capacitance at UHF. The capacitors should be miniature 'plate' or 'disc' types to obtain low self-inductance. The capacitor values are all non-critical. Any value +/− 50% of the nominal value will work (i.e: from 27p to 100p for C1, C2 and C3). Note that the trimmer, CV1, should have the moving plates grounded so that the alignment screwdriver will not detune L1 when you come to adjust CV1. With the capacitor type used on the prototype, a 'flat' on one side identifies the 'hot' (i.e: non-grounded) fixed plates. (See Figure 4).

Short lengths of small diameter coax should be terminated to the input and output lands on the board, as shown with the overlay and wiring diagram. Teflon insulated coax is best for this, or else take great care and solder swiftly using a hot iron. First tin the shield braid and the area of board groundplane to which it will be soldered. Attach supply positive and negative (ground) wires last.

A quick dc check will indicate if you've got it together properly. With a supply of around 12-14 volts connected, see that the unit draws close to 5 mA.

Installation and tune-up

This project could be installed as a masthead amplifier or inside a transceiver. Owing to the great variety of differing circumstances likely to be encountered, we can only give general guidelines. ▶

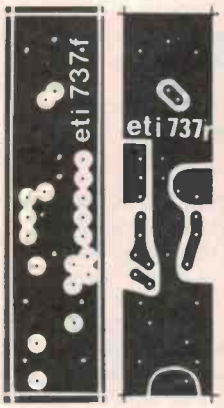
HOW IT WORKS — ETI-737

The preamp is designed around the BFR91 which achieves a noise figure of 2 dB or better between 400 and 500 MHz and exhibits a high margin of stability. In addition, it has good dynamic range together with input and output impedances close to 50 ohms when biased for best noise figure. It is a bipolar device and hence has good immunity to electrostatic damage.

The BFR91 is employed in the grounded emitter configuration. Bias is provided by R1, direct from the collector, which is shunt fed via R2. This arrangement provides for dc bias stability with variation in temperature. If the temperature increases, the base current of Q1 will tend to increase, drawing more current via R1. However, the tendency for the base current to increase will be offset by the increase in collector current dropping the collector-emitter voltage, thus robbing the base of bias current as R1 is tied to the collector.

The input tuned circuit is a tuned, single-wire unbalanced transmission line (L1) working above a groundplane provided on the top surface of the pc board. This is tuned to resonance by CV1. This arrangement has a relatively low Q. The antenna input is tapped directly onto the line (L1). The base of Q1, being a close match to 50 ohms, is tapped onto the same point, coupled via C1 which simply provides dc blocking. The collector of Q1 is coupled to the helical output filter set via C2. As the collector output impedance is also close to 50 ohms, no special matching arrangement need be made, here. Capacitor C3 provides bypassing at UHF while C4 provides bypassing at the lower frequencies.

Overall gain achieved is about 13 dB, although stage gain would be around 15-16 dB but there is some 3 dB loss in the helical output filter set. Bandwidth is essentially determined by this filter and measured 20 MHz at the −3 dB points. Measurements suggest a noise floor of around −130 dBm which equates to a 2 dB noise figure. Out of band rejection was measured to be in excess of 35 dB.



PARTS LIST — ETI-737

Resistors.....all ¼W, 5%
R1.....47k
R2.....1k
(Resistors should be carbon or metal film types, e.g: Philips CR25 or MR16, respectively)

Capacitors
C1, 2, 3.....68p min. ceramic
C4.....1n min. ceramic
CV1.....1-20p min. trimmer

Semiconductors
Q1.....BFR91 or BFR91A

Miscellaneous
FL1.....Toko helical filter set, 252MX-1506A/7HW for 440 MHz (D.S.E. L-1850) or 252MX-1507A/7HW for 47 MHz (D.S.E. L-1860).

ETI-737 pc board (double-sided G10 fibreglass); length of 22g tinned copper wire; length of RG174/U 3 mm diameter 50 ohm coax (preferably teflon dielectric); hookup wire, etc.

Price estimate: $19-$21

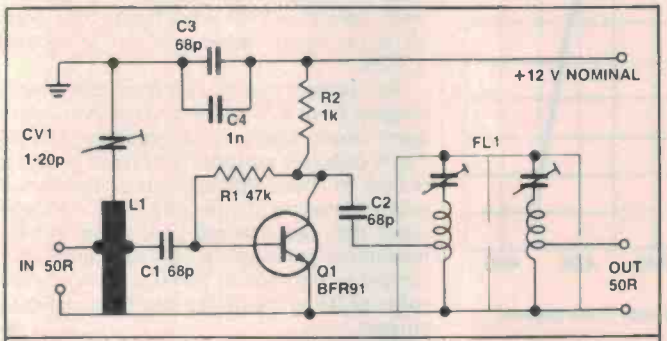
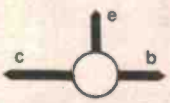


Figure 3. Circuit of the preamp.



BFR91 PINOUT

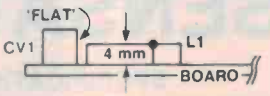


Figure 4. Showing construction of the input tuned line, L1 and orientation of the tuning trimmer, CV1.

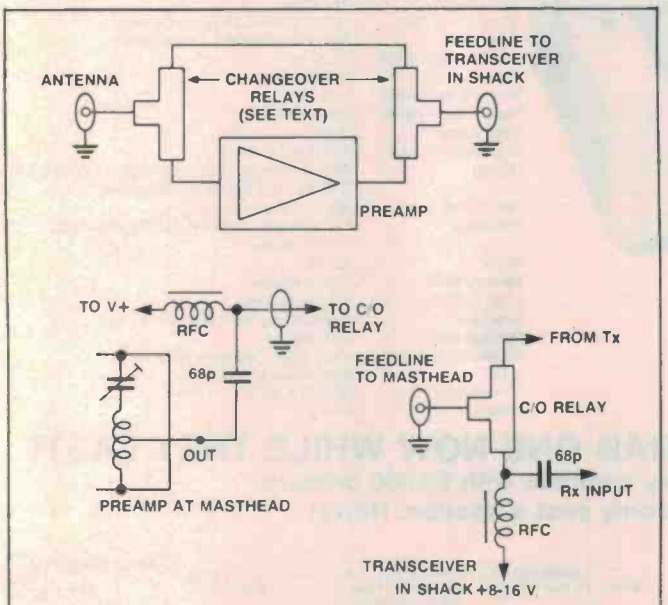
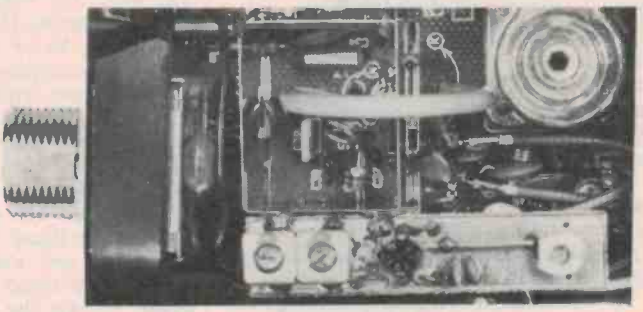


Figure 5. Showing typical installation as a masthead amplifier. Arrangements for dc feed via the coax shown below.



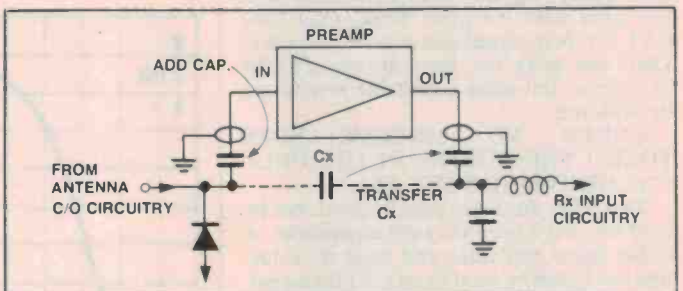


Figure 6. Showing typical installation inside a transceiver. Just insert it in place of the input coupling capacitor between the antenna changeover circuitry and RF stage input. Above. Photograph of the preamp installed in a common UHF rig, according to the circuit principle shown here.

In a masthead installation, apart from the obvious weather and grounding considerations, the unit has to be switched out of the line when transmitting. Even if only moderate powers are used, changeover relays of the type which ground the unoperated connection should be used. The supply voltage can be either via a separate wire or the coax centre conductor, as illustrated in Figure 5.

In a transceiver, the unit should be installed between the antenna changeover circuitry and the input of the RF stage. A typical input circuit and the modification is shown in Figure 6.

For a preliminary tune-up, you can pick a local signal (e.g: a beacon), attenuate it at the input until it's quite weak, then tune CV1 for *best signal-plus-noise/noise ratio*. Don't just 'peak' the signal. By ear, it's a bit of a fudge, but quite acceptable results can be achieved.

UNDER NO CIRCUMSTANCES TOUCH THE SCREWS IN THE HELICAL RESONATOR SET, FL1.

Two other methods, equally good, can be used but you'll need the right equipment. A stable signal generator and noise & distortion meter can be used to set CV1 for *signal-plus-noise/noise ratio* at a given distortion or for minimum distortion (that's what your goal is, after all). Alternatively, a stable noise source and an ac voltmeter can be used to set CV1 for *minimum noise figure*. The necessary equipment and technique for this is described in the ARRL's *Radio Amateurs' VHF Manual*.

Performance

The measured bandwidth was 20 MHz at the −3 dB points (Figure 7). Mid-band gain was 13 dB. As for dynamic range, the output −1 dB compression point was −3 dBm (0.5 mW), the output saturating at −2 dBm (0.7 mW). When installed in a UHF rig that gave a sensitivity of 1 μV for 12 dB SINAD, sensitivity improved to 0.25 μV for the same SINAD.

The results you get will entirely depend on the noise figure of the existing front end. Note that you won't achieve an overall noise figure equal to the preamp's noise figure because the existing front end also

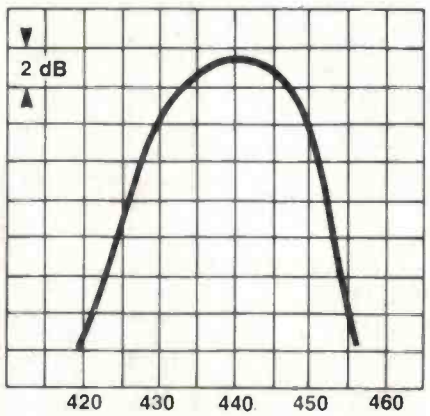


Figure 7. Measured bandwidth of the preamp.

contributes some noise. The overall noise factor of a receiving system is given by:

$$F = f_1 + \frac{f_2 - 1}{G_1} + \ldots \frac{f_n - 1}{G_n \ldots G_2 G_1}$$

where f_1 is the noise factor of the first stage
f_n is the noise factor of the n^{th} stage
G_1 is the gain of the first stage
G_n is the gain of the n^{th} stage

It's obvious from this equation that the first stage largely determines the noise figure and, if the gain of this and succeeding stages is greater than one, the denominator of each term becomes greater. Thus, the numerical value of the terms beyond the second or third stage rapidly approaches zero and can be ignored.

As an example, if your preamp has a 2 dB noise figure and a gain of 13 dB and your receiver a 5 dB noise figure, the overall noise figure works out to be around 2.3 dB.

The project can be run from any supply ranging from 8 V to 16 V. However, optimum noise figure is obtained at around 5 mA collector current (see Figure 1) and it is best to check this and adjust the bias if you're powering the preamp from a voltage other than the nominal 12 V or so. A milliameter in the supply lead is sufficient (base current is only about 50-60 μA). Vary the value of R1 to obtain the optimum collector current. ●

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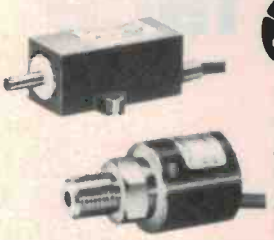

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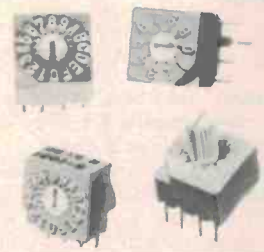

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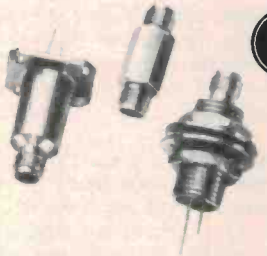

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Scan Delay:	Normal. Approx. 1 second With Delay Option Approx. 2.5 seconds
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Amateur radio and the face of change

Roger Harrison VK2ZTB

Great structural and technical changes have occurred within amateur radio in the past two decades. The proliferation of VHF mobile operations and repeaters; the CB boom, the Novice licence and influx of newcomers from that source; the integration of microcomputers into the 'shack', are but several examples. Amateur radio looks set for tremendous growth and change from now to the turn of the century. How will the amateur fraternity cope?

TODAY, right now, amateur radio stands at a crossroads. Never in the history of the hobby have we faced such a challenge as that which now stands before us. The next two decades will bring changes to amateur radio so profound, and with such speed, that the developments of the last two decades will seem but wrinkles in the fabric of the past.

Over the past 20 years some pretty radical changes, both technological and structural, have occurred in amateur radio. I was fortunate to be born at such a time that I could not only observe, but participate in, an era of profound change. I have had my licence now for just on 20 years. I entered the hobby at the zenith of the valve era, when the 807, the 12AX7 and QQE06/40 reigned supreme. 6CW4 Nuvistors and 7360 beam switching mixers represented 'high technology'. Single-sideband was a four letter word, espoused by the technically forward-looking, misunderstood and derided by those who clung to the standards of the past. By the mid-1960s SSB was the dominant mode on the HF bands and was just making its presence felt on the bands 50 MHz and up. Overcrowding on the HF bands created a technological imperative and SSB was the solution.

Twenty years ago there were two licences — the full and limited; debate on a 'novice licence' was very new. The concept was espoused by the forward-looking, derided by those who clung to the past. Twelve years on, the Novice Licence was a reality.

Twenty years ago the great mass of amateur stations comprised a hodge-podge collection of adapted surplus military or commercial equipment and homebrew adjuncts. 'Commercial ham gear', what little there was of it, was for the well-endowed or extravagant ham. A very few stations were built from scratch. Transceivers were a rarity. Netting was an art. Ten years later, transceivers were legion, the great majority were commercially manufactured for the amateur market and very few stations were built from scratch, still. (Though, numerically, the number has probably risen as solid-state techniques provided a more "accessible" technology.

Twenty years ago solid-state devices, while available on a very limited scale, were rarely seen in amateur gear. Ten years later solid-state devices had almost completely pervaded amateur equipment. At that time, analogue integrated circuits were a mere ten years old, were rarely available and rarely seen in amateur gear. Digital ICs were younger and even rarer. The microprocessor has not yet been invented. Five years on from then, (that is, five years ago) that scene had changed totally. Today, sophisticated and highly complex large-scale integration ICs are common in amateur stations, along with the microprocessor and the machine that grew out from that — the microcomputer.

The integration of the microcomputer into the amateur station will, I think, prove the catalyst that sparks off a new round of technological advancement within amateur radio. Amateurs are already moving into various forms of digital communications as well as adapting older modes to the newer technology. The modern amateur RTTY station is built around a "glass teletype" — a microcomputer and VDU.

Somewhere down the track I expect we'll see interactive "robot" stations which will test the communciations path parameters and set up the equipment for optumum results to suit the mode chosen. For example — finding the optimum working frequency on HF for the path selected and setting the antenna radiation pattern and transmitter power level before you call CQ, then optimising everything during your contacts. Or, another scenario might be where a robot-equipped station automatically tracks a satellite, sets the transmitter power and receiver parameters for best signal-to-noise ratio plus compensating for doppler shift etc, all interactively in real time.

I would expect that, before too much longer, we'll see 'communications mode converters' which convert, say, RTTY to speech and vice-versa, as well as real-time language converters — Japanese-to-English, for example — that translate *as you speak*. These developments will come about as a result of the convergence of computer and communications technologies.

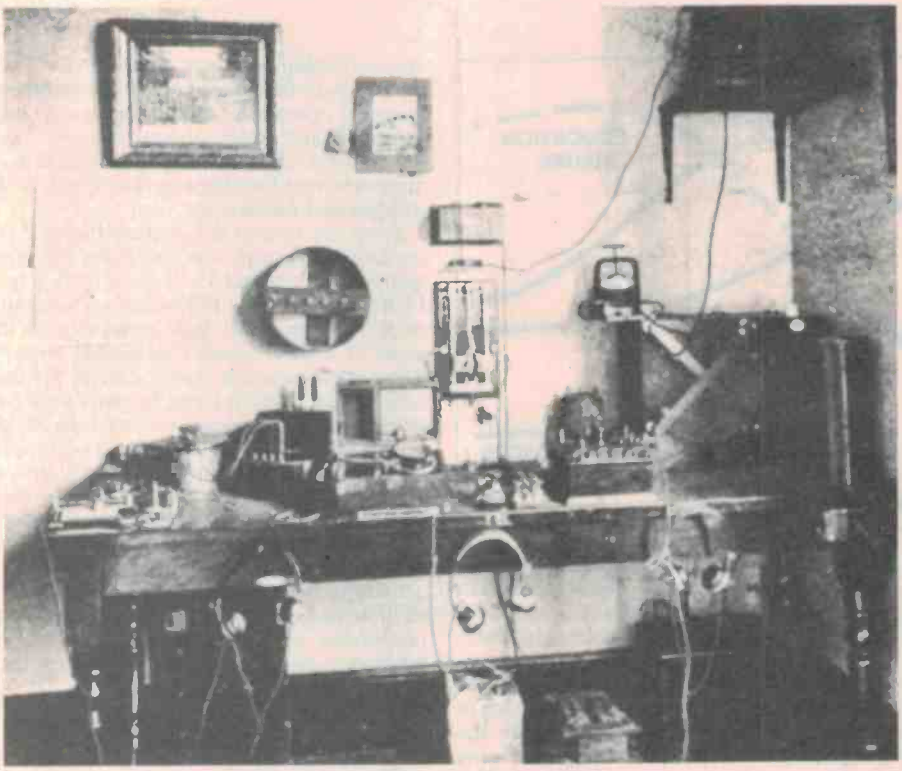
I think you will all readily admit that technological advancement will continue to create change in the hobby — after all, it is an interest in the technology that *fundamentally attracts* most amateurs and this interest provides the drive to explore new directions.

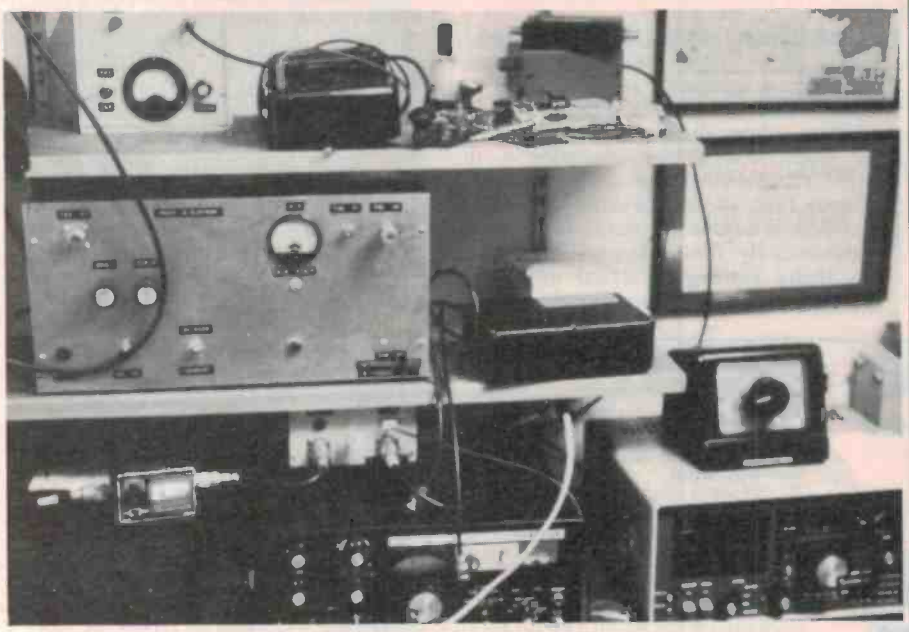
However, it is not technological change alone that will have the greatest influence on amateur radio in the next two decades, but also the pace and character of social change — what happens in the world around us.

Australia, and indeed the greater part of the western world, has experienced great social and economic change since the Second World War. Our current standard of living, our work patterns and our lifestyles are largely a product of that era. The social and economic upheavals we have experienced in the decade just past have set the stage for a future which may be difficult to comprehend, but will doubtless arrive.

By the year 2000, people will have much more leisure time than they do now, their working life will be shorter and they will be better educated. As a result, I believe, leisure pursuits of a technical nature will rise *dramatically* and the interest in amateur radio will rise along with it. Industries serving the demands of these technical leisure pursuits will boom as a result.

But, to support my hypothesis, we need to look into the past a little.





The face of change. At top is the well setup pre-WW I amateur station. The emphasis was on individual component construction, though not everything was homemade. (From *Wireless Telegraphy for Amateurs*, by R. P. Howgrave-Graham; circa 1911). Below is an example of a modern-day amateur station. The 'primary' gear (transceiver, receiver) is commercial with homemade adjuncts. The emphasis, thse days, is on system engineering to provide flexible operating options. (Photo courtesy Andrew Kay, VK2YLA).

Historical patterns

The first industrial revolution totally changed the way people lived and worked in Britain and Europe in the 18th Century. Mechanisation radically and rapidly altered the face of agriculture. In "Learning to Live with the Revolution" (*The Bulletin*, 6 Sept. 1983, p. 58) the writer, Collyn Rivers, points out that in the mid-1700s some 65% of Britain's workers farmed the land. This fell to less than 50% in the 1780s and, aided by increasing mechanisation, to 11% by 1950, and a mere 3% by 1891. It has remained constant since. Rivers noted that farming ceased to be the major source of employment in the eastern states of America by 1860, in Australia by 1870, in the Soviet Union by 1947.

For a time the major source of employment became manufacturing and mining, but only barely exceeding the service industries, he said. In Britain percentages were equal (35% : 35%) in 1810, ". . . rising to about 35% industrial: 45% services by mid-century, and falling again to equality a decade or two later. These percentages remained about equal *until 1950*, when the service sector leapt ahead, to nearly *60% by 1980*." (Our italics . . . Ed.).

In 1830 over 70% of US workers bred animals or grew crops. This fell to 47% by 1833, to 25% a hundred years later, and to 3% in the mid-60s: remaining constant since. This change is mirrored by the increase of those in US service industries — *to 50% by 1933* and more than *70% in 1983*. Australia was spared the full upheaval of the first industrial revolution. "*At no time* in this country's history has manufacturing been the major source of employment." (our italics . . . Ed.).

The Colonial census of 1871 even then showed half the workforce in service industries, according to Rivers. Australia was the *first nation to have a service-based economy*, and in that era probably the highest per capita income in the world. The percentage of Australians employed in service industries has grown ever since. It is currently 71% or so. "Mechanisation made large-scale manufacturing an economic reality. Technology developed and refined the products and the processes enabling greater quantities of increasingly complex devices to be made with correspondingly fewer people involved."

"Increasing automation will reduce that workforce further," says Rivers.

The trend to less working time and increased leisure time is perhaps best illustrated by the rise in part-time employment. From late 1974 to 1979 there was a decline of 44 000 full-time jobs in Australia and an increase of 233 000 workers in part-time employment.

Expanding automation and cybernation in the workplace will not only contribute to the reduction of jobs available, but reduce the period worked in a year by full-time employees. At present, those in full-time employment have their year divided into, on average, 228 working days and 137 leisure days. This will be *very nearly reversed* by the end of this century, according to Kahn and Weiner in this book *"The Year 2000"*. They predict that, by then, the year will be divided into 148 days of work and 217 days of leisure.

Western society has moved from an agricultural economy (pre-industrial) to an industrial economy (where manufacturing predominated), to a post-industrial 'services' economy where most workers are employed in the so-called service industries (retailing, banking, advertising, entertainment, transport et al). That's where we are now — but, services employment is on

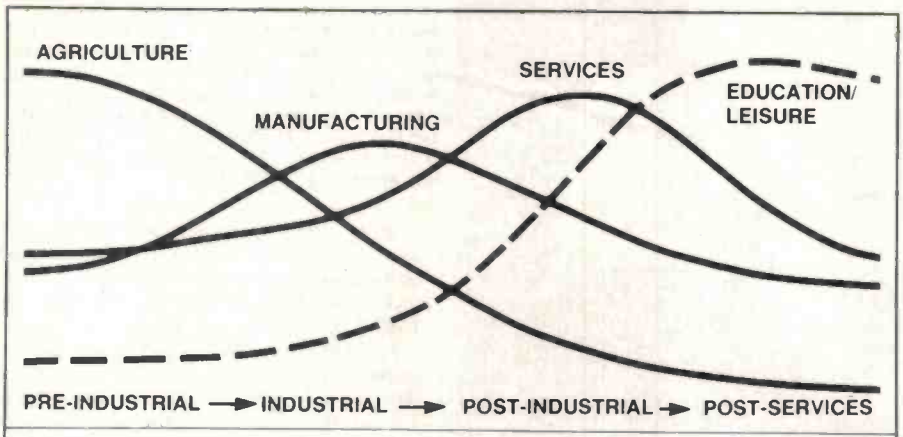


Figure 1. Historical progression from a pre-industrial to a post-services economy.

the decline. These overlapping cycles are illustrated in Figure 1, from *"Sleepers, Wake!"* by Barry Jones (now Federal Minister for Science & Technology). The rise of the post-services economy has already commenced and will be based on education/leisure activities.

Filling in the time

What will people do with the leisure time available; work? Hardly. Pay rates now generally allow people to pursue non-work activities in the leisure time available and this trend is predicted to continue. Undoubtedly, some will turn to technical pursuits, in part fuelled by increased awareness and education in scientific and technical matter.

In the 1950s, when there were around 30% fewer leisure days in the working year, fewer than 10 magazines on the Australian market serviced technical hobbies. By the mid-1970s the number had not doubled, but at present more than 40 are available (not all locally-produced admittedly, but that was never the case throughout the period in question, anyway). If you look at the electronics-based publications alone, viz: those covering electronics, computing, communications etc, the diversity is *staggering*. There are now a range of magazines specialising in a single defined area (e.g: especially the computing magazines covering just one model or one narrow range of models). This reflects the specialisation in interest as well.

Education, work and leisure

Today, more people are staying in education beyond secondary school and do not enter the workforce until their mid-20s. In addition, many already in the work-force are supplementing their education — the larger proportion of them doing technical courses. From the turn of the century to just post-WW II technical tertiary education was predominantly trade-oriented (boilermaking, motor-winding, electrical wiring etc) and conducted part-time, generally through apprenticeship schemes. In the 1950s, the transition to full-time, more broadly based technical education occurred leading to the expansion and proliferation of the universities and the establishment of tertiary institutes intermediate between trade technical colleges and universities.

From the turn of the century through to the late-1960s, a person's working life was figured to be around 45-50 years. (from age 15-20, to age 65). Following retirement, male workers could look forward to 7-10 years of leisure, females somewhat longer. The past decade has shown a trend for the retiring age to drop some 10 years and the working life of a person to shrink to 30-35 years. This indicates many more years will be available in a person's working life where non-work activities will be pursued. Such activities will be divided between education and leisure.

Amateur radio, being a technical leisure activity, will obviously attract a percentage of these people who will spend a significant proportion of their non-work years and hours pursuing their hobby interest.

Amateur radio — facing the change

With people having greater leisure time and better education than before entering the hobby, some stress will be placed on the 'structure', partly through sheer numbers and partly through the differing backgrounds, attitudes and experiences of the newcomers. Going back to the CB 'boom' years, 1972 through 1978, many amateurs who held a licence from before that time will remember the 'dislocation' experienced in the social structure and organisation that occured within the hobby then. CBers brought distinctly differing attitudes, backgrounds and experiences with them. Predominantly, CBers had non-technical

backgrounds but their interest in the technical aspects of communications, aroused by their experiences on the air, and the comparative freedom and scope offered by amateur radio, attracted them. But few moved into amateur radio until an 'entry level' to suit their needs and background was produced. That was the Novice Licence, which appeared in 1976, having been seriously mooted some 15 years or so earlier.

It seems it was the Novice Licence that provided for the rapid growth of amateur licencees from 1975.

I believe the present licensing structure, and the amateur regulations, will stifle both growth (from newcomers) and technological development within the hobby, making it restrictive to many existing amateurs and unattractive as a hobby pursuit to those seeking an outlet for their technological leisure interests, unless something is done so we can cope with the coming changes.

The present licensing structure provides three 'entry points' to the hobby. Viz:

The Novice licence
The Limited licence
and The 'Full' licence

The Limited licence is actually an adjunct to the full licence. The Novice licence is the first "new" licence to be introduced since amateur service licensing began.

Specialisation within the ranks of amateurs began very early. The major specialisation that appeared early was VHF techniques. Following the burgeoning of activity in the post-WW II years, particularly on VHF, pressure for a specialised licence arose, culminating in the introduction of the Limited licence in the early 1950s. The same technical and regulations exam as the full licence applied, but the morse code exam was not required. A few short years later, when commercial television reached our shores, amateurs who wished to conduct TV transmission experiments couldn't . . . until the '/T' qualification was introduced; acquired after sitting for an additional examination. (This requirement, and the /T, was dropped some years ago).

Much more diverse specialisation, now arising, will place similar pressures on the existing licensing structure in years to come. An 'all-encompassing' licence does not really provide for the needs and interests of specialists. An examination for such a licence would not only be daunting to devise but would represent a formidable barrier to many potential amateurs.

"Sticking to the fundamentals" will rapidly become an impossible exercise as the convergence of computing and communications technologies so broadens the fundamentals from the basic electronics and communications topics now covered that one would need a considerable portion of a higher tertiary qualification to cope. I'm not suggesting that such a licence level should not exist, though. What I am suggesting is that the number, classification and coverage of entry points should be considered. Perhaps we need more entry points (examinations, licence classes) to cope with the spectrum of specialisations the hobby will face in the future.

The current regu tions, and those proposed under the new Radiocommunications Act, will also have a stifling influence, I believe, on the growth and development of amateur radio. For example; at present, the permitted transmission modes are all classified and defined in the regulations. Now, one of the fundamental precepts of amateur radio is "experimentation". If you want to experiment with spread spectrum transmissions, for example, the current regulations prevent you. You *may* get individual permission . . . and you may not. The point is, experimenting with an undefined transmission mode is not available to you. Indeed, experimenting with hitherto underfined techniques is prevented by the regulations.

I don't propose we do away with the regulations, rather that the way in which they're framed should be examined with a view to removing the sort of restrictions they impose while maintaining the rights and privileges of other amateurs and spectrum users. A point to remember, it was amateurs who pioneered the use of single sideband and who were the first to widely adopt it in daily use.

How will amateur radio cope with the influx of newcomers and increased band population? While it is true that, in recent years the spectrum space allocated amateur radio has expanded, notably in the allocations between 1.5 and 30 MHz, it has done little to alleviate crowding. The problem is even evident on VHF at times (particularly in other countries with high amateur populations, like the US and Japan).

It was a technological imperative — the prospect of crowding and its attendant interference — that led to the adoption, by 'gentlemen's agreement', of single sideband as the predominant voice mode on the HF bands. I believe it will be the same technological imperative that will force the introduction of new modes that allow greater band occupancy while reducing mutual interference or keeping it to 'acceptable' levels. I can foresee the growth of compressed spectrum and spread spectrum transmission modes and the decline of SSB as a result.

If amateur radio is to survive, let alone cope with, the profound social and technological changes that are taking place in our society, then the whole structure of the hobby needs careful examination and overhaul or reinforcing where necessary. The ability to change in the climate of external change, rather than stand fast and stagnate, will ensure a prosperous, healthy, exciting future for amateur radio where the horizons can expand to the limit of the collective imagination of the fraternity.

I said, at the beginning, we stand at a crossroads. One way leads back and to oblivion, one way leads off to an uncertain future and one way leads forward, where the laneways expand. Which way shall we choose? It's up to us.

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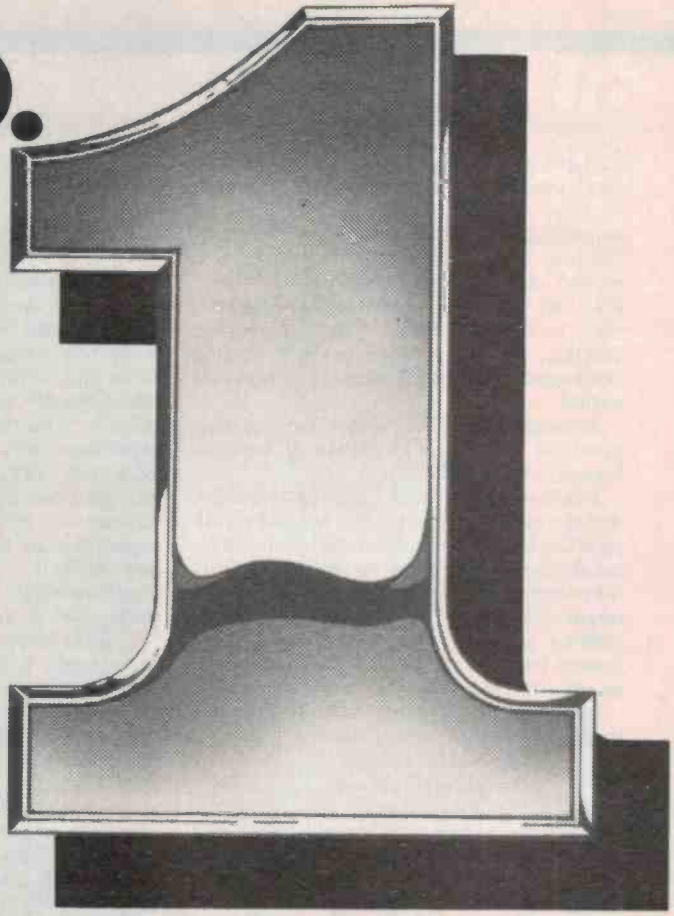
We're No.



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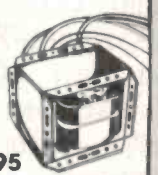

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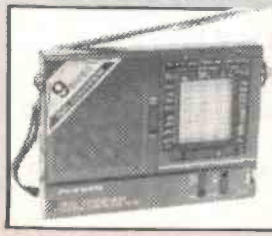

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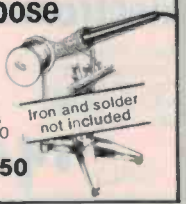

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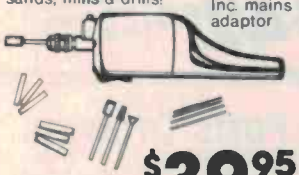

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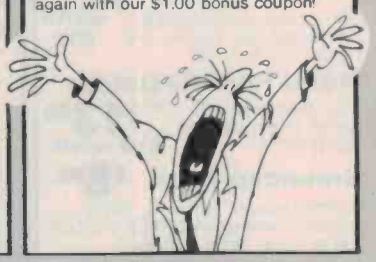

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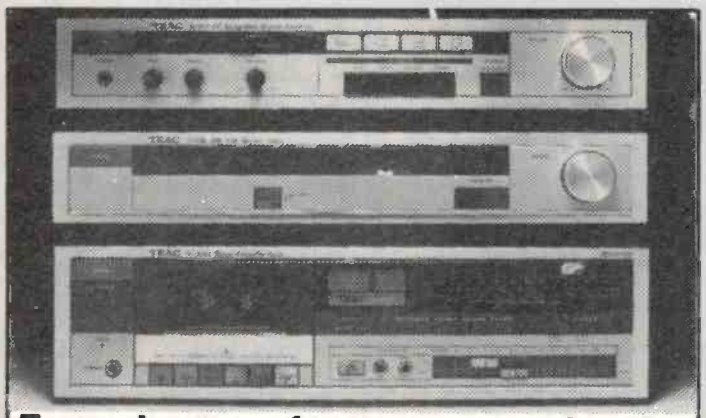

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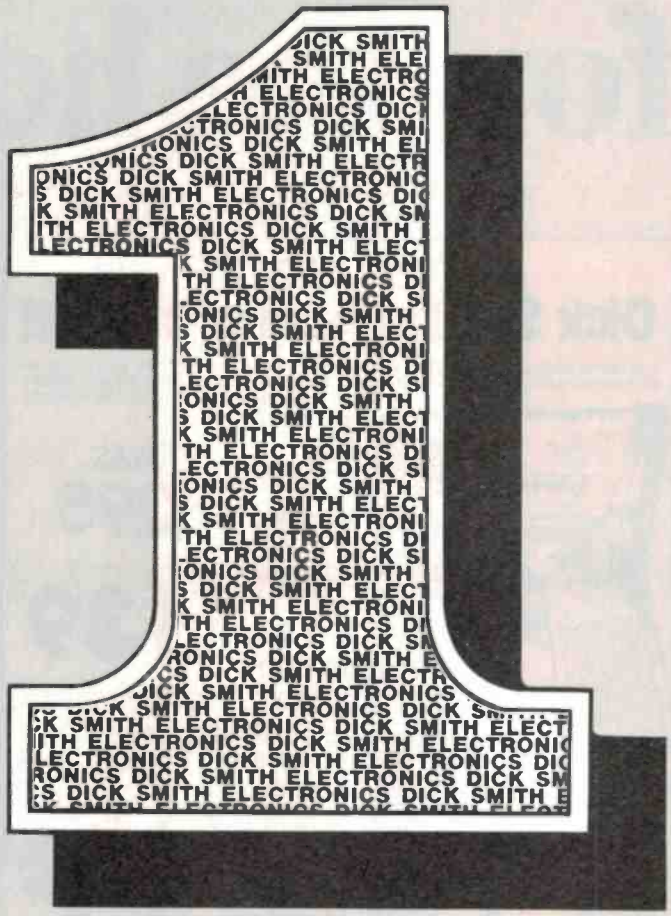

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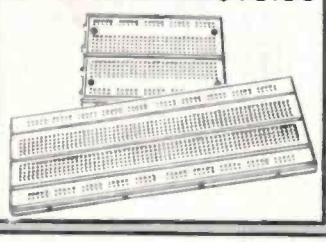

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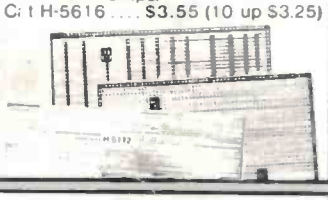

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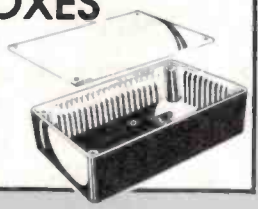

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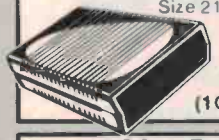

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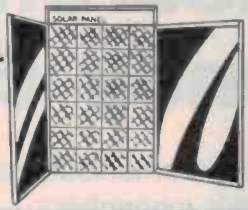

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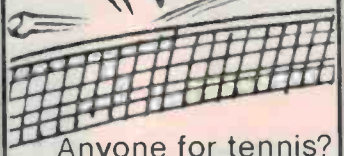

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The role of ionospheric measurements in high frequency communications

High frequency communications is still widely used in Australia. As it depends on the Earth's ionosphere — the ionised upper layers of the atmosphere between 60 and 800 km — and its variable nature (there's 'weather' up there too!), sophisticated measurements and predictions techniques are employed to get the best in performance and reliability.

David G. Cole

Ionospheric Prediction Service
Department of Science & Technology

HIGH FREQUENCY (HF) radio remains the most versatile, mobile and inexpensive form of communications and broadcasting. Its availability for long and short distance circuits; its portability for emergency situations; its advantage for broadcasting over large areas where transmitter and receiver costs need to be kept low; all these facts make the HF spectrum a vital ingredient in the world telecommunications scene and one for which spectrum space is eagerly sought.

And yet HF radio communications systems are still subject to the vagaries of the earth's ionised environment. HF radio makes makes use of a natural phenomenon, the ionised region of the earth's upper atmosphere, the *ionosphere*. Methods of creating artificial ionospheres at convenient circuit reflection points have been mooted, but for the foreseeable future HF radio will continue to employ the natural ionospheric plasma.

Like most natural phenomena, the ionosphere is constantly varying, sometimes slowly, following well established patterns, sometimes more dramatically with potentially disastrous results for HF communications if these are taken unprepared.

How are communicators and broadcasters to make the best use of the ionospheric support for their circuits? They have invested in equipment designed in most cases to use the latest communication electronics; how to ensure a good match between manmade standard equipment and a natural variable environment?

The answer lies in . . .

The answers lies largely with measurements; measurements of the ionospheric parameters themselves but also measurements of external inputs causing variations in the ionosphere.

Sir Edward Appleton was among the scientists who began early measurements of the ionosphere in 1925. Today, measurements using rockets, satellites and ground-based radars give a detailed picture of the ionosphere. for the purposes of mapping ionospheric weather over specific circuits, over lengthy periods of time (months to years) only ground-based measurements are extensively used. Sophisticated high technology radar systems are used to probe the ionosphere in detail at a few sites, while simpler ionosondes sited worldwide sound the ionosphere regularly to provide information for radio communicators and scientists.

In simple terms, the radio communications engineer or operator needs to know

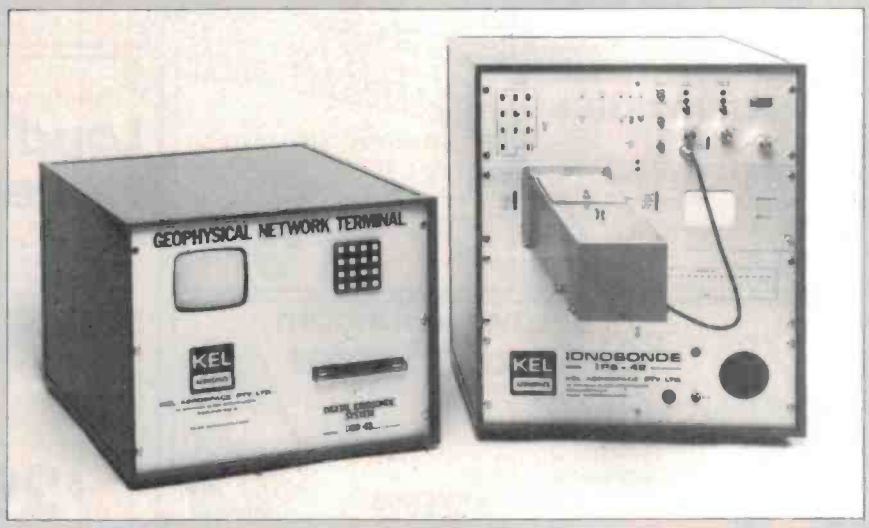
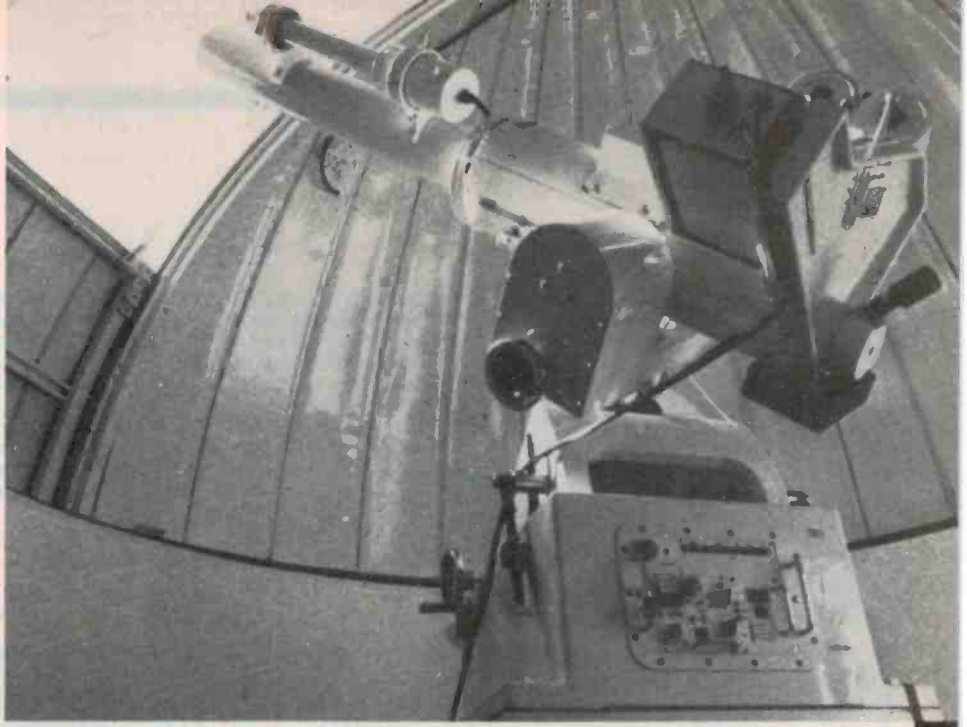


Figure 1. The ionosonde is the basic tool for measuring the Ionosphere. Shown on the right here is the IPS-42 ionosonde, originally designed and developed by the Ionospheric Prediction Service (as the 'Type 4A') for their station network, it has been further developed and is marketed by local manufacturer KEL Aerospace who have sold systems all round the world.

The IPS-42 comprises a swept frequency radar that sweeps from 1 MHz to 22.6 MHz in logarithmic steps. Pulse power output is 5 kW nominal, pulse width 41.67 μs. It gives three pulses per channel at



Solar telescope. This solar optical telescope is used to monitor the sun's activity from the IPS Observatory at Culgoora (NSW).

which of his allocated radio frequencies will provide the most reliable communciations over his specific circuit.

Sophisticated systems are capable of automatic frequency management, the frequency being selected on the basis of measurements made along the specific circuit. The measurments made can vary. A swept frequency radar sounding obliquely along the circuit can be used to identify the frequency bands that will minimise the number of propagation modes possible, and hence reduce the fading distortion. A particularly promising measurement, that provides a good indication of the quality of ionospheric propagation, is that of the Doppler spread in signal frequency as the signal passes through the ionosphere. There would be little spread if the signal was ideally reflected from a mirror-like ionosphere. A large spread indicates a greater complexity in ionospheric propagation mode and hence a greater error rate or more distortion. Doppler tone sounding is performed obliquely along the circuit in question, in parallel with the transmitted signal. An automatic assessment of the Doppler spread in frequencies around the transmitted signal is relayed back to the transmitter which then can automatically select the signal frequency providing the best quality.

The operator of a general communications system will need to know which is the best frequency to use throughout the different time periods over which he is operating. Preferably the operator of the circuit will need to know his frequency plan in advance so that his counterpart at the receiving site can be following the same plan.

Predictions

Techniques have been available for some time that allow radio frequency predictions to be made well in advance (weeks) that give the radio communicator time to match his frequency plan to the measured regular variations of the ionosphere with time of day, season and general solar cycle activity. Discrete variations outside the regular variation can be forecast in the short-term (hours) by measurements of the ionosphere itself and of the Sun, the external source of sudden variations.

Both the long term predictions and the short-term forecasts of regular and irregular variations affecting communications rely on measurements. The basic tool of measuring the ionosphere is the *ionosonde*, a swept-frequency radar that sounds the ionospheric region vertically above it (Figure 1). Oblique sounding of the ionsophere is also ▶

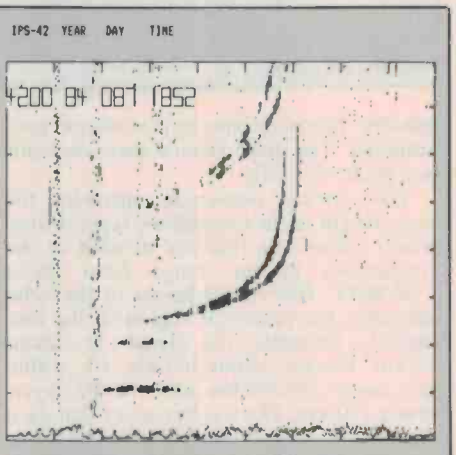
5.33 ms intervals. Pulse returns are compared and non-coincident returns are rejected, providing a record (Ionogram) that is relatively free of noise and interference. It displays pulse returns over the virtual height range of 50 km to 800 km, height markers on the ionogram (see right and Figure 2) being at 100 km intervals, frequency markers being at 1.0, 1.4, 2.0, 2.8, 4.0, 5.6, 8.0, 11.3, 16.0 and 22.6 MHz. The transmitter and receiver are controlled by a 576-channel digital frequency synthesiser. The ionograms are recorded on 16 mm film.

In general, soundings are made every 15 minutes, although this can be varied. A maximum of three soundings per minute can be made (it takes 20 seconds to complete a sounding). As the antenna system employed 'fires' vertically, with very little ground radiation, and because the ionosonde fires three pulses at about 6 ms intervals on each channel, interference from the equipment is rarely experienced by other spectrum users, even within close proximity to the installation. It definitely doesn't make a racket like the over-the-horizon (OTH) radars such as the well-known Russian "Woodpecker".

The IPS-42 can be mains or battery operated (24 Vdc) and has been used in temporary 'portable' applications, such as making soundings in the shadow of a solar eclipse.

While most Ionosondes are used for gathering data to be used in generating forward predictions, KEL Aerospace has developed equipment for real-time use. Their DBD-43 Geophysical Network Terminal provides for storage, in digital form, of soundings as well as real-time control of the ionosonde either on-site or remotely. Soundings are stored on a 20M, 600' serial tape cartridge which can store up to 1000 Ionograms. The DBD-43 is capable of replaying ionograms in time-lapse sequence which shows dynamic variations of the Ionosphere in a graphic way, particularly during disturbances. High resolution ionograms can be dumped to a printer, even from a remote location (half the world away!) via a standard telephone data link. Scaling of the parameters from the ionogram and calculation of the M(3000) propagation factor is also possible. A fully-scaled ionogram, reproduced direct from a DBD-43 printout, is shown at right. (The squiggly line just above the bottom graticule here and in Figure 2 is the receiver AGC voltage).

As a demonstration of the real-time capability provided by the DBD-43, Terry Kelly, proprietor of KEL Aerospace, whilst attending a Hong Kong Ionospheric conference in March this year dialled the system installed at his Asquith (NSW) factory and obtained a printout of the ionosphere above Sydney taken a minute previously — all controlled via terminal and modem at his end. For real-time frequency management in HF communications systems, such a capability obviously provides a powerful tool.



FREQUENCY SWEEP FROM 1 TO 22.6 MHz.

SCALED PARAMETER VALUES

fmin	= 2.01	MHZ	QL=	DL=
foE	=	MHZ	QL=	DL=
h'E	= 100	KM	QL=	DL=
Es types	=			
foEs	=	MHZ	QL=	DL=
fbEs	= 2.76	MHZ	QL=	DL=
h'Es	= 100	KM	QL=	DL=
foF1	=	MHZ	QL=	DL=
h'F	=	KM	QL=	DL=
foF2	= 7.44	MHZ	QL=.	DL=.
fxI	= 8.27	MHZ	QL=	DL=
h'F2	= 243	KM	QL=A	DL=
M(3000)F2	= 3.78	MHZ	QL=	DL=

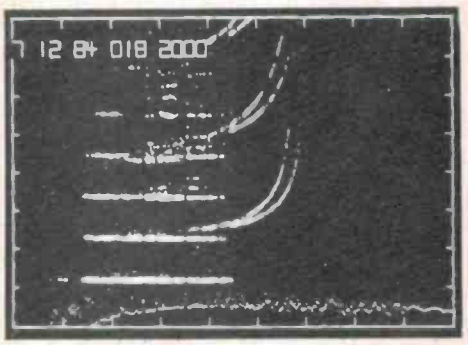


Figure 2. An ionogram taken at vertical incidence. The lowest (flat) layer here is due to Sporadic-E at at height of just over 100 km. The layers seemingly 'stacked' at regular intervals are actually the result of multiple reflections between the layer and the ground. The F-layer can be seen rising from a height of about 250 km. The F-layer can be seen rising from a height of about 250 km. The 'forked' appearance comes from the "ordinary" and "extraordinary" rays which undergo difficult propagation delays.

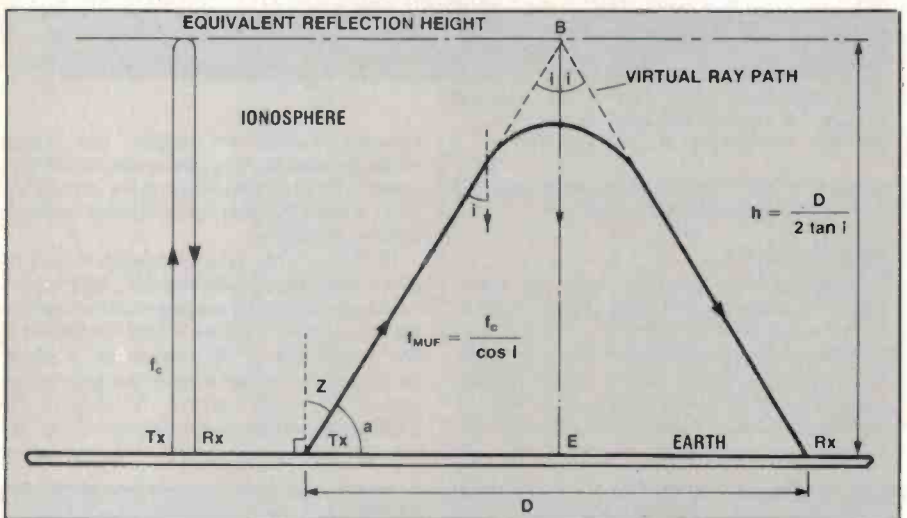


Figure 3. Simple Ionospheric propagation theory, showing the paths and important parameters (plane Earth approximation).

possible but is specific to the oblique path sounded. The more general measurements are made vertically.

The vertical ionosonde measures the basic height of the ionospheric regions from which echoes are returned at each of the frequencies in the range from about 1-30 MHz. The virtual height of the echo identifies the particular region of the ionosphere reflecting the signal: D, about 70 km, E-layer, about 100 km, F1, within the range 150-250 km and the F2 layer, above 250 km. The top frequency that each region can reflect is the critical frequency of that region. (Figure 2). The *critical frequency* of the layer is the maximum radio frequency that the layer will support in vertical communications. To convert these vertical frequencies to oblique frequencies they must be multiplied by the *obliquity factor*. This is a geometric factor dependent on the obliqueness of the circuit (Figure 3).

A conventional ray path from transmitter (Tx) to receiver (Rx) via the ionosphere is shown in Figure 3. The elevation angle (a) at which the signal leaves the transmitting site is the complementary angle to the zenith angle (z). The actual path of the signal, shown as a solid line, is curved. The apparent or virtual path of the signal, if it had undergone a mirror-like reflection is shown dashed. If the frequency of the signal is the highest possible, the MUF *(Maximum Usable Frequency)*, then the *virtual height*, h, turns out to be the same as the reflection height of a vertically incident ray at the mid point of the path.

$$MUF = k\ f_c \sec(i)$$

$$\sin(i) = R\cos(a)/(R + h)$$

where f_c is the *critical frequency* of the reflecting layer at the 'reflection' point, and k is the *obliquity factor* that takes into account the curvature of the earth (k=1 for near-vertical propagation and about 1.18 for a 4000 km path).

Thus we see that it is necessary to be able to predict the vertical incidence critical frequency at the midpoint of the circuit in order to predict the MUF.

The Australian network of ionosonde stations (Figure 4) provides a data base of critical frequencies measured for different times of day, season and solar activity at their location. These data, with similar data from other stations in a world-wide network, are the basis for world maps of ionospheric characteristics.

A geographical grid is used to map the data, interpolated from the station sites. A statistical model of the ionospheric parameters as they vary with solar conditions is made so that each grid point map of the data can give the value of an ionospheric parameter, such as critical frequency, expected at that point, at a particular hour and for a particular level of solar activity, for 90% (upper decile), 50% (median) or 10% (lower decile) of the month in question.

The Australian network of ionosondes stretches from Vanimo in PNG to Macquarie Island, from Norfolk Island to Mundaring near Perth (Figure 4). The data from these ionosondes are those most needed for operational communications or for scientific research. They include the critical frequencies (vertical) of the E, F1, F2 layers, the height of these, and the maximum and minimum frequencies observed. The critical frequency, height and types of sporadic-E layers are also measured.

These measured data characterise the ionospheric support offered to HF communications at any point on a radio circuit: the MUF, the absorption limit to propagation, the mode of propagation and the time delay between different modes. The measurements therefore allow us to calculate the reliability expected for any frequency operated on the radio circuit.

These predictions of MUFs, absorption limited frequencies (ALFs), circuit path loss, reliability are all long term in as much as they make use of statistical data measured over each month. Provided the general state of solar activity can be predicted accurately in advance, it is possible to provide predictions months in advance of use. However, within the month of actual use the ionosphere will vary about its average predicted behaviour and this variation can be critical to some radio circuits. Further short-term measurements are needed to fine tune the long term predictions.

The routine short-term measurements not only involve the ionosondes but also include measurements of the Sun and its output.

The ionosonde data gives a 'snapshot' view of the ionosphere at any given moment. Any sudden changes unpredicted in the long term can be relayed to vital communication stations where new operating frequency plans are put into force.

The Sun's influence

The sun itself is in constant turmoil and during its more violent outbursts will emit large amounts of radiation (X-ray, ultraviolet) and ionised plasma clouds which can interfere with many terrestrial systems, especially HF radio communications.

The regions of particular solar activity are monitored, with optical and radio telescopes and by satellites above the earth's atmosphere, world-wide twenty-four hours each day. Any sign of incipient activity,

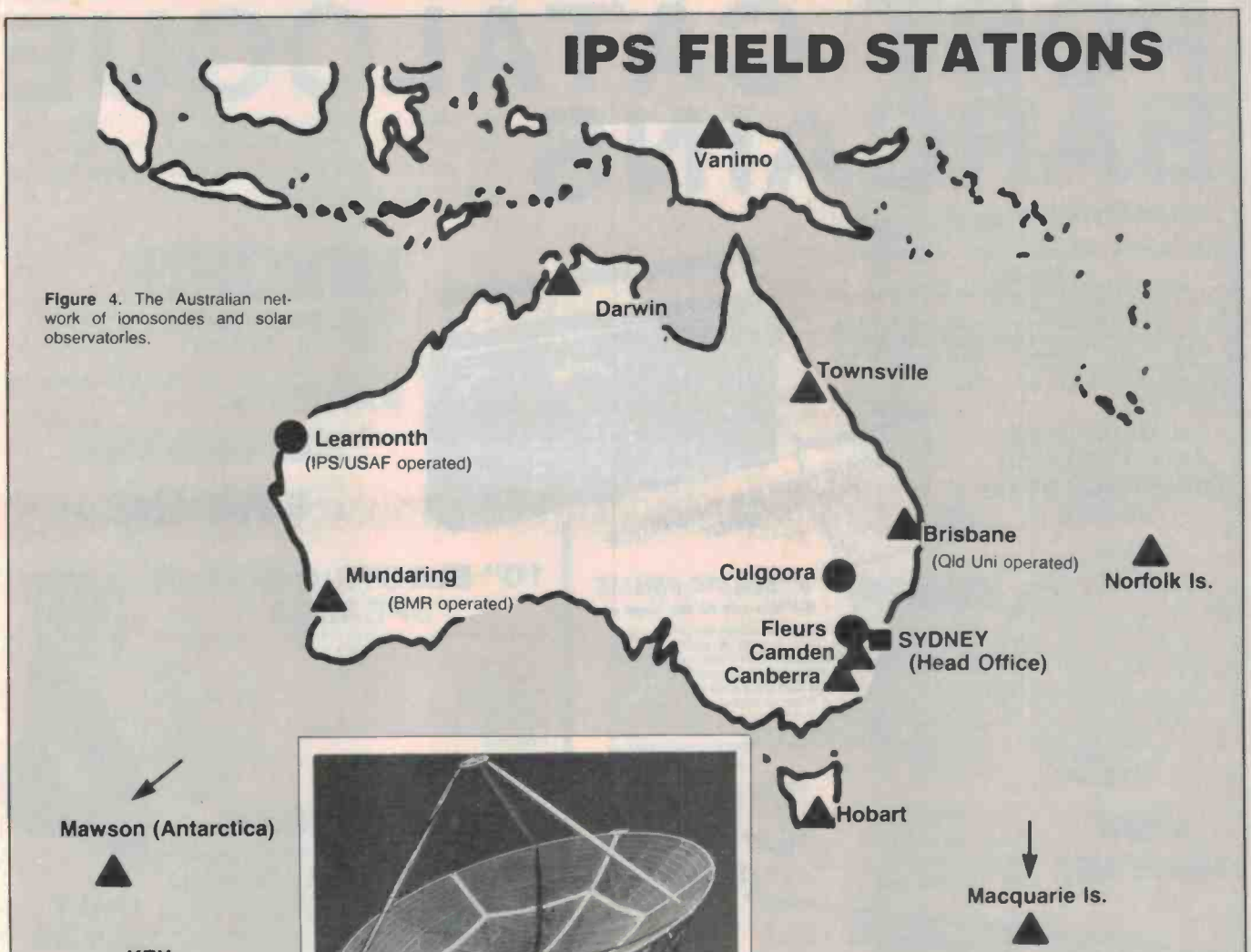


Figure 4. The Australian network of ionosondes and solar observatories.

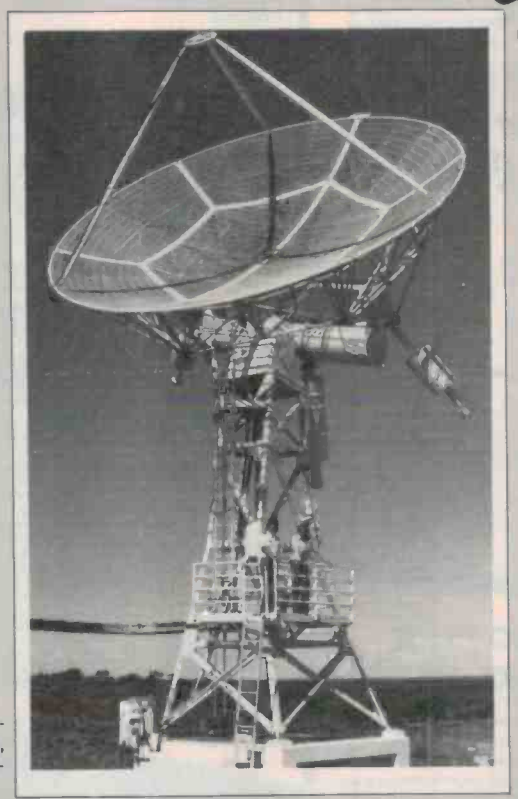


Figure 5. The solar radio telescope at the IPS observatory, Learmonth (W.A.), used to measure the Sun's activity.

such as highly contorted magnetic fields (measured by optical telescope in the solar spectral lines) or high speed streams of solar plasma (seen by both optical and radio telescopes), are reported around the world. Each short-term forecasting agency, such as the Ionospheric Prediction Service (IPS) Australasian Regional Warning Centre in Sydney, assesses the data and, if the assessment indicates a terrestrial disturbance to communications, will issue an alert which in most cases allows one to two days warning before the effects take place.

As part of the Australian short-term forecasting system, IPS operates and observes at three solar observatory sites: Culgoora, near Narrabri (NSW), Learmonth, near Exmouth (WA), and at Fleurs, to the west of Sydney. At Culgoora, IPS observers monitor the sun through optical telescopes, to measure the energy output from solar flares that may, if great enough, cause short-wave radio fadeouts. They can also observe the passage of a plasma cloud through the sun's atmosphere, if one should erupt, by means of the CSIRO radiospectrograph. This vital equipment can measure the speed and energy content of the plasma cloud, hence giving an estimate of the time delay before it arrives near the earth.

The Fleurs observatory measures the magnitude of solar flares at radio wavelengths thereby providing an assessment of their energy and their possible effects to HF communications.

The Learmonth Solar Observatory is jointly operated by IPS and the US Air Force. It is part of a network of solar observatories among the world which measure the sun's activity with radio and optical telescopes.

The data from these observatories plus data from other observatories, when the sun is below the Australian horizon are the basic raw data necessary to provide up-to-the-minute information on our space environment and on disturbances to HF radio communications. ●

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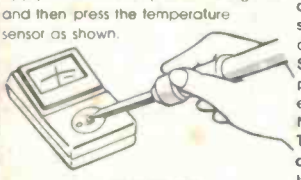

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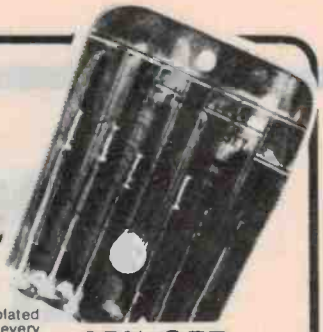

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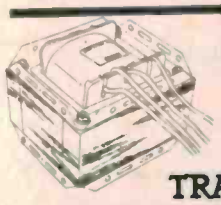

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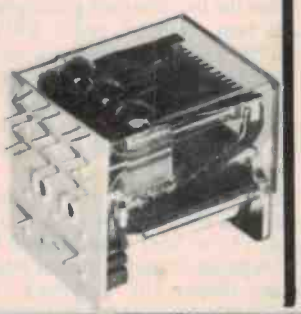

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Shortwave broadcasting in the Pacific region

In this special article Arthur Cushen looks at the shortwave services which are operating in the Pacific and beyond. There are more than 40 countries with daily broadcasts in English to this area. Listeners are fortunate that we live in an area which is famous for its medium and shortwave reception, that we are furthest away from the intensity of broadcasts in Europe and we therefore experience less jamming and other interference than the more densely populated areas of the world.

Arthur Cushen

IN THE SOUTH PACIFIC, Radio Australia reflects the views, news and interests, not only of Australia, but also using a considerable amount of material from the countries in the Pacific area. It is the major voice of this region in international broadcasting.

This is a specialised shortwave service from Melbourne. On the other hand, Radio New Zealand relays its internal domestic service on shortwave which reflects the radio scene as heard within the country. This is a very commendable feature for most shortwave listeners as they feel they can eavesdrop on what the New Zealand audience is listening to as the service is not tailor-made for overseas consumption.

This is also the case in many smaller stations in the South Pacific which all relay their own domestic medium-wave service and it is only in the case of Guam and Saipan where high powered broadcasters are carrying a specialised shortwave service for an overseas audience. In this case, two stations' transmissions are based on gospel programming and the other on a popular music format.

Broadcasters to the Pacific from stations in all five continents are received at a time suitable for either morning or evening listening in the area and using frequencies which propagate well to the South Pacific many countries can be heard under the best reception conditions when beaming programmes to this area.

During these winter months signals received during the daylight hours on lower frequencies will provide the best reception. Two stations outside the area operate a 24-hour a day service in English with selected portions of the transmissions for our reception as do the BBC World Service and Radio Moscow World Service are audible for most of the 24 hours.

This review of transmissions of the South Pacific only includes stations which have a shortwave relay but many other countries are heard on medium-wave when reception is possible after dark.

AUSTRALIA: Radio Australia operates 24 hours a day in English from transmitters at Shepparton, Lyndhurst in Victoria, Carnarvon (Western Australia) and Darwin (Northern Territory). Transmissions are carried also in Indonesian, Standard Chinese, Cantonese, Japanese, Neo Melanesian, French, Thai and Vietnamese, for listeners in the Pacific and Asia, though transmissions are received in Europe, North America and Africa on unscheduled frequencies.

News is broadcast in English on the hour every hour, and there is Australian news for 10 minutes 0130, 0430, 0830, 1230, 1630, 2030, and 2230 UTC. World and Pacific News for 10 minutes is heard at 0900, 1000, 1800, 1900 and 2000 UTC. The transmissions for local morning reception in the area are best on 5995, 6035, 9505, 11 725 and 11 790 kHz, while later in the day, around 0200 UTC, signals should be received on 15 160, 15 240, 15 310 and 17 795 kHz.

Evening listening in the area is available on many frequencies around 0700 UTC including 11 910, 15 320, 15 395 and 17 715 kHz. Later in the listening day signals are received on 11 820, 15 160, 15 320 and 15 390 kHz around 2300 UTC.

A programme of special interest to shortwave listeners is 'Talkback', compered by Barry Seeber, which is broadcast on Sundays at 0210, 0530, 0810 and 2110 UTC.

COOK ISLANDS: The Cook Islands Broadcasting & Newspaper Corporation, Rarotonga, operates on 11 760 kHz with the low power of 500 W, and is heard when conditions are favourable up to closing time at 0900 UTC. Broadcasts are in English and Maori and several of the news bulletins are relayed either from Radio Australia or Radio New Zealand.

GUAM: KTWR, Agana, Guam is operated by Trans-World Radio and carries gospel programming to the Pacific and Asia. The transmission in English for Australian listeners is broadcast 0845-1000 UTC on 11 840 kHz.

Broadcasts in many other languages are observed and a special programme of interest to the shortwave listener is 'DX Listeners Log' heard on Saturdays at 0915 UTC. KTWR operates four 100 kW transmitters and is one of the Trans-World Radio network of stations with the main office in Monte Carlo and other transmitters on shortwave in Swaziland and on the Island of Bonaire in the Caribbean.

NEW CALEDONIA: Australia's nearest neighbour, New Caledonia, operates on 666 kHz medium-wave, and can be received during darkness and on 3355, 7170 and 11 710 kHz with broadcasts in French 1900-1115 UTC.

The shortwave transmitters use 20 kW, except 11 710 kHz which runs 4 kW, and are widely heard throughout the Pacific area.

NEW ZEALAND: Radio New Zealand Shortwave Service carries programmes to the Pacific, Australia and Papua New Guinea and operates from 1800-1215 UTC. The entire programme service is a relay on the non-commercial national programme, but there is some inserted material for listeners in the Pacific Islands broadcast in Maori, Samoan, Cook Island Maori, Niuean, Tokelauan and Tongan languages.

Radio New Zealand's major news programmes are 'Morning Report' 1900-2000 Sunday-Thursday, 'Mid-Day Report' 0000-0025 Monday-Friday, and 'Checkpoint' 0600-0630 Monday-Friday. News is gen-

erally broadcast hourly except 2200, 0100, 0700, 0800, 0900 and 1100 UTC. Radio New Zealand news originates from 2YA Wellington and local news from the Wellington area is also heard through the Shortwave Service.

Broadcasts to the Pacific and Australia-Papua New Guinea are at present carried on 6105 kHz 0530-1215; 11 960 1800-2100, 0530-1215; 15 485 1800-0515 and 17 705 from 2100-0515.

Radio New Zealand uses a power of 7½ kW and commenced operation 27 September, 1948.

NORTHERN MARIANAS: KFBS, operated by the Far East Broadcasting Company with its headquarters in Manila, is a new gospel station operating from Saipan. The station is using a 100 kW transmitter and has two further units on order and plans to expand the service with a further two 100 kW transmitters at a later date.

Broadcasts are beamed to China and the Siberian area, and the test transmissions included announcements in English, Japanese, and Chinese. The tentative schedule for broadcasts is 0900-1100 on 15 115 kHz, 1100-1500 on 15 150 kHz, 1500-1730 on 15 110 and 2100-2400 15 125 kHz.

KYOI, with the slogan 'Super Rock', is a commercial shortwave station broadcasting in English and Japanese and aimed at the teenage audience in Japan. The station carries transcribed music which is pre-recorded in the United States and includes commercials in Japanese and English. KYOI uses 100 kW and the schedule is 1600-2200 on 9670; 2200-0300 on 15 405; 0300-1000 on 15 190 and 1000-1600 on 11 900 kHz.

PAPUA NEW GUINEA: The National Broadcasting Commission carries a Port Moresby programme on two shortwave frequencies, 3925 and 4890 kHz, which are audible during our mornings from sign-on at 1930 through to close-down at 1400 UTC. The programme is in English, Pidgin and local dialects.

There are many provincial stations operating in Papua New Guinea and these can be heard in the 75, 90 and 120 metres bands. There are 19 such stations broadcasting local programmes, and can be heard on these lower frequency bands during our late evening listening in the South Pacific. The programmes are generally of popular music, or folk music of the area, and the pidgin announcements make identification relatively easy.

POLYNESIA (FRENCH): Radio Tahiti at Papeete is well received throughout the Pacific area on its two main frequencies, 11 825 and 15 170 kHz. the transmissions are in French and Tahitian with sign-on at 1600 through to 0730 UTC with a later sign-off on Saturdays at 0900. Two other frequencies with lower power are used, 6135 and 9750 (both 4 kW), while the higher frequencies use 20 kW.

Signals on 15 170 are heard during our local daytime, while towards evening 11 825 kHz is also audible. Programmes are a relay of the domestic service and French transmissions have been noted up to 0300 when the programme changes to Tahitian.

SOLOMON ISLANDS: The Solomon Islands Broadcasting Corporation provides excellent reception during local evenings on 5020 kHz until closing at 1130 UTC. A further frequency, 9545 kHz, is scheduled 2030-0730, but suffers from severe interference. The transmissions on 5020 kHz carry news in English 0800 and 1100 and pidgin news is broadcast at 0800, after the English news.

VANUATU: Radio Vanuatu at Port Vila is well received in the area during our evenings on 3945 kHz up to sign-off at 1100. Broadcasts are in English and French with the balance in pidgin. English news is noted at 0815 Monday to Friday, and French at 0830 UTC. The transmission suffers some interference from the Japanese commercial station opperated by NSB, Tokyo, also using 3945 kHz.

Medium-wave signals are received after dark from many other countries in the South Pacific area, including Fiji on 558 (English) and 774 kHz (Fijian); Kiribati on 846 kHz; Niue Island on 837 kHz; Norfolk Island 1566; American Samoa 648; Western Samoa 540 and 1404; Tonga 1017; Tuvalu 621; and Wallis Island 1188 kHz.

Broadcasts to Australia

There are 44 countries broadcasting programmes in English for listeners in Australia each day, and this summary covers only the more reliable signals and also gives a variety in the areas of transmission.

AUSTRIA: The Austrian Radio, in Vienna, broadcasts to the Pacific area in English 0830-0900 UTC on 15 270 and 17 830 kHz. Other English broadcasts are 0330-0400 and 0430-0500 on 5945 and 9770 kHz. The Austrian Radio also has a special programme for the shortwave listener carried on Sundays, 'Austrian Shortwave Panorama' broadcast at 0900, dealing with international developments in radio and other modern means of communication.

BELGIUM: BRT, the Belgium Radio & Television operated by the Dutch section of the Belgium Radio, has a new transmission to the Pacific, 0715-0800 UTC, using 9880▶

A PRACTICAL MANUAL FOR SHORTWAVE LISTENING

The World in My Ears, *by Arthur Cushen M.B.E., Published by the author, Invercargill New Zealand.*

THIS BOOK must rate as the basic manual for anyone involved in, or contemplating taking up, shortwave listening. It is a veritable *fund* of information on virtually every aspect, practical and historical, of shortwave broadcasting and the worldwide army of listeners who indulge their interest — whatever the motivation.

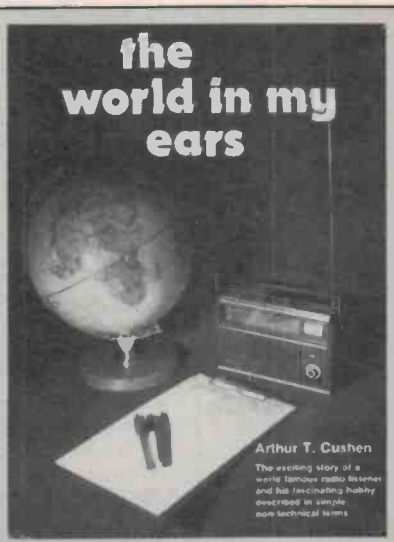
The book is fundamentally divided into two sections; Part 1 covers the historical development of shortwave broadcasting and Mr Cushen's early involvement. The personal anecodtes and experiences related in this section raise the book above a 'straight' historical text as it relates developments in human terms, including how Mr Cushen lost his sight and how this misfortune led him to develop his hobby into a profession, motivated by his and his wife's urge to help others, particularly the sight handicapped. The nine chapters in Part 1 make fascinating reading as a background to shortwave listening as well as a social document.

Part 2 of this book covers the practical aspects of listening in eleven chapters — right from that fundamental question *"What is Shortwave?"* Mr Cushen discusses various types of modern receivers and how to set up for listening, antennas and time conversion (a big stumbling block for many newcomers foreign language broadcasts, propagation and frequency ranges and medium-wave (broadcast band) listening. The two final chapters covers shortwave listening as a hobby — how to make reports, 'DX' clubs and special listening tips; the last chapter covering international broadcasting, including a very useful listing of "English News Around the Clock — 100 News Bulletins that keep you informed". Personally, I think that listening to overseas news broadcasts gives you a much broader view of world events, certainly a remarkably different 'slant' to that which you hear on local news services or read in the daily press. Even if you only ever take up shortwave listening on a casual basis, as against becoming involved in it as an absorbing hobby, Mr Cushen's book is worth it for this chapter alone.

The book was first published in 1979 and a small amount of information in it is thus dated but nothing so drastic that you couldn't find the information you needed from the *World Radio & TV Handbook* (published annually and distributed by various DX associations and specialist book stores).

If you're contemplating "dabbling your fingers" in shortwave listening, or have been listening for some time, then this book is thoroughly recommended.

Roger Harrison



The World in My Ears, ISBN 0 472 00019 0, by Arthur T. Cushen, published and distributed by Arthur T. Cushen, available in Australia through ETI Book Sales, No. N0420C (see pages 129 to 132, this issue).

and 21 810 kHz. The broadcast is Monday-to-Friday, on the other two days a relay of the Home Programme is broadcast. The feature is called 'Brussels Calling' and on Tuesdays letters from listeners are answered in the programme 'Post Box 26'.

CANADA: Radio Canada International is received during our local afternoons with English 0300-0330 and 0400-0430 on 9755 kHz. On Monday, the programme 'Shortwave Listeners Digest' is featured, and a repeat of this transmission is available on Saturday 2130-2200 on 15 150, 15 325 and 17 875 kHz. A service to Africa provides excellent reception 0600-0700 UTC with English at 0615 and again at 0645 for 15 minutes Monday to Friday on 6045, 11 775 and 11 825 kHz.

CHINA: Radio Beijing broadcasts to this area in English 0830-0930 and repeated 0930-1030 on 9860, 11 600, 15 435 and 17 765 kHz. Radio Beijing broadcasts almost continuously in English to all parts of the world and also carries transmissions in 42 other languages.

CZECHOSLOVAKAI: Radio Prague has two daily transmissions to Australia 0730-0800, 0830-0900 on 11 855, 17 840 and 21 705 kHz. On Sundays, an additional service 0900-0930 is carried on the same frequencies. During our local afternoons transmissions are also received with English 0300-0357 on 9540, 9630, 9740, 11 800 and 11 990 kHz.

ECUADOR: HCJB Quito, Ecuador, the world's pioneer gospel radio station, has a daily transmission to the South Pacific 0700-1000 UTC using 6130, 9745 and 11 925 kHz. The programme includes transcribed gospel broadcasts and on Monday and Saturday 0930-1000 the 'DX Party Line' broadcast is featured which includes information on the latest changes in shortwave broadcasting.

HCJB is heard in many other transmissions, particularly in the service during our mornings to Europe, 2130-2200 on the frequencies of 15 295, 17 790 and 21 480 kHz.

GERMANY WEST: Deutsche Welle, Cologne, has two transmissions to this area, 0930-1020 UTC on 9650, 9770, 15 275, 17 800 and 21 540 kHz. The other broadcast 2100-2150 is on 7130 and 9765 kHz. Afternoon reception in this area is available 0500-0550 on 9545, 9690 and 11 705 kHz.

BEGINNING LISTENING

THERE ARE two fundamental things you need to understand if you're new to shortwave listening: Frequencies (and 'bands') and time.

Frequencies: stations broadcast on a particular frequency or set of frequencies, usually expressed in *kilohertz* or *megahertz*. The *Hertz* is the fundamental unit of frequency; one cycle per second. The prefix *kilo* means 'x 1000', and thus kilohertz means thousands of Hertz. the prefix *mega* stands for 'x 1 000 000', meaning millions of Hertz. A station around the middle of the dial on your car radio may be on a frequency of 1000 kilohertz, or one megahertz (often marked as '10' on the dial). Kilohertz and megahertz are abbreviated to kHz and MHz, respectively.

The dials on most modern receivers are now marked in kilohertz or megahertz. Older receivers used to have the *wavelength* marked in metres; some receivers had both. There is a connection between the two — the *wavelength* of a particular frequency can be found by dividing 300 by the frequency in megahertz, giving the result in metres. Take 10 MHz, for example: 300 divided by 10 gives *30 metres*. Simple! The *frequency* of a given wavelength is found by dividing 300 by the wavelength in metres. Thus the frequency of a 25 metre signal is 300/25, or 12 megahertz.

Shortwave broadcast and other services are allocated *bands* between 3 MHz and 30 MHz, by international agreement. Each band covers a small range of frequencies and the bands are generally known by the nearest appropriate wavelength. Thus, the band from 7100 kHz to 7300 kHz is known as the *41 metre band* (abbreviated to 41m).

There are nine shortwave broadcast bands:

11m	25 600 — 26 100 kHz
13m	21 450 — 21 850 kHz
16m	17 550 — 17 900 kHz
19m	15 100 — 15 600 kHz
22m	13 600 — 13 800 kHz
25m	11 650 — 12 050 kHz
31m	9500 — 10 000 kHz
41m	7100 — 7300 kHz
49m	5950 — 6200 kHz

The 11m band was little used until the last decade. The 22m band is a new one, allocated at the World Administrative Radio Conference in 1979 and only just coming into use. That conference also increased the range of frequencies available in the eight older bands (but 11m was reduced).

So, if you see an interesting station listed as being on 9565 kHz, then you'll know it's in the 31m band. If your dial is marked ". . . 9, 10, 11" . . . etc (in megahertz), then it will be about halfway between 9 and 10 (as 9565 kHz is 9.565 MHz).

Many modern shortwave receivers have a digital readout which gives the frequency directly in kilohertz, down to 1 kHz. Those which do not generally have a well-calibrated dial which shows frequencies every 50 kHz at worst, or 5 kHz more usually. Some receivers have two dials — one dial which covers a wide frequency range and has general calibration with the MHz intervals relatively close together, and the other dial being a *bandspread* dial that gives

HOLLAND: Radio Nederland, Hilversum, broadcasting through its relay base at Bonaire in the Caribbean, provides excellent reception in two transmissions. 0730-0820 on 9715 and 9770 kHz, and 0830-0920 on 9715 kHz. This broadcast includes the popular 'Media Network' programme on Thursdays which includes contributions from reporters in the South Pacific, Asia, Africa and North America, and the writer is heard on the first Thursday of each month.

Radio Nederland's transmission for our morning reception 2030-2130 are received on 9895 and 15 220 kHz.

INDIA: All India Radio, Delhi, has a service to this area 1000-1100 UTC on 15 170, 15 320 and 17 875 kHz. The morning transmission for this area 2045-2230 is on 9595, 9912 and 11 755 kHz.

JAPAN: The Radio Japan service to Australia 0845-0945 UTC is on 11 875 and 15 235 kHz. The programmes include 'Hullo Australasia' on Sunday, a special broadcast for listeners in this area, and on Monday there is 'Radio Japan DX Corner'.

SWEDEN: Radio Sweden, Stockholm, uses 17 860 kHz for its daily transmission 1100-1130 UTC. This broadcast to Australia includes a Mailbag session on Sunday and on Tuesday, 'Sweden Calling DXers', the longest continuous DX programme on shortwave bands.

Radio Sweden has also introduced a transmission in Swedish for this area, 1000-1030 UTC on 17 820 kHz.

SWITZERLAND: Swiss Radio International broadcasts to the Pacific 0700-0930 with English 0700-0730 and 0900-0930 using 9560, 15 305, 21 520 and 21 695 kHz. On the second and fourth Saturdays 'Swiss Shortwave Merry-Go-Round' is presented in both transmissions and can also be heard on Sunday during the broadcast 0430-0500 on 9725 and 11 715 kHz.

UNITED KINGDOM: The BBC Service operates 24 hours a day with three transmission periods beamed to this area. From 1700-2200 UTC broadcasts are on 5975, 7325, and 9410 and from 2000 9570 kHz is used.

Transmissions from 0600-0915 are available on 7150, 9510, 9640 and 11 955, while for reception after 0900 UTC signals on 11 750, 15 070, 17 705 and 21 550 kHz provide reasonable reception, though during our winter 11 750 kHz through the Singapore relay will be the most reliable signal.

The broadcast of interest to the shortwave listener is 'Waveguide' heard on Monday at 0915 UTC, repeated Tuesday 0100, Wednesday 0430 and 1735 UTC.

UNITED STATES: The Voice of America transmissions to Oceana, 2200-2400, are received on 11 760, 15 290 and 17 740 kHz as well as other frequencies. Evening listening in this area finds the VOA opening at 1100 UTC on 6110, 9565 and 11 715 kHz. The United States Armed Forces Radio & Television Service also provides continuous news and feature programmes and is received during our afternoons on 11 805 and 17 765 and after 0600 on 0630 and from 0900 on 9530 and 9590 kHz.

USSR: Radio Moscow World Service operates 24 hours a day in English and with relays through their Siberian relay base provides excellent reception day and night.

During our afternoons in this area, at 0300 UTC 17 880 and 21 530 kHz provide the best reception, and at 0900 Moscow is scheduled to broadcast in English in all wavebands on at least 42 frequencies, with transmissions in this area best received on 9450, 11 950, 15 420 and 17 880 kHz.

In this summary, reception of both daylight and signals received during the hours of darkness have been included due to the change to better daylight reception this month. It is not possible to list all frequencies carrying the transmissions indicated, but those which give the most reliable reception are included. ●

This article was contributed by Arthur Cushen, 212 Earn St. Invercargill, New Zealand, who will be pleased to supply additional information on medium and shortwave listening. All times quoted are UTC (GMT) and all frequencies are in kilohertz (kHz).

'slower' tuning and 'spreads out' the frequencies. You set the main dial at the 'start' (lowest frequency) of a band and use the bandspread dial to tune across the band, from the lowest frequency.

Time: the *24 hour clock* is universally used; there is no am or pm, saving any confusion. The hours from midnight to midday run from 0000 to 1200. From midday to midnight, the hours go 1200, 1300 (1 pm), 1400 (2 pm) etc . . . to 2400. In addition, times are given in Greenwich Mean Time (GMT) — the time at the zero degrees longitude meridian which runs through Greenwich in England — or UTC (coordinated universal time), which amounts to much the same thing for listening purposes. Local times are not usually mentioned as broadcasts generally cross time zones.

If you live in Sydney, Australia, and are listening to a British Broadcasting Corporation (BBC) overseas broadcast, your local time will be *10 hours ahead*. If it's midnight in London, it's 10.00 a.m. in Sydney!

It's handy to keep a desk clock with your receiver set to UTC — better still if it's a 24 hour digital type.

Get to know your time zone — how far ahead (east) of Greenwich time or how far behind (west) your locale happens to be. Western Australia is 8 hours ahead, central Australia (N.T. and S.A.) is 9½ hours ahead, eastern Australia is 10 hours ahead, New Zealand is 12 hours ahead.

TUNING IN

From published lists or schedules, you will find the times and frequencies on which a station of interest to you might be broadcasting. So you find the frequency on the dial and . . . nothing happens! There can be a multitude of reasons. Firstly, check that the station is broadcasting to your area at that time and that the schedule is current. If it's broadcasting to another area, then you *may* not hear the station because it could be using a directional beam to maximise its coverage in the 'target' area. If 'conditions' are favourable, you might hear it, but weaker than it otherwise would be. Reception depends on 'reflecting' the signal from the electrified layers in the Earth's upper atmosphere, called the *ionosphere*. The ionosphere has its own 'weather' patterns — daily, seasonal and year-to-year variations, dependant on the sun. There's no space to go into it here, but there are times when reception will be 'out' for you. If you're a beginner setting out to listen, then pick a number of different stations you may want to listen for so that you have several choices up your sleeve — it can not only avoid frustration, but might lead you to explore the reasons why you *didn't* hear a particular station at a particular time.

Apart from that, choose stations and/or broadcast sessions that are *in your native tongue*, unless you're a fluent multi-linguist, in which case you don't need this advice. It's a whole lot easier tuning in to and recognising broadcasts in a language with which you are completely at home. Later, having learned something about different languages from your own study, you can tune in and identify unknown stations.

When you've found your way around the dial after a bit of listening to known or easily identified stations, then finding other stations becomes that much easier.

Roger Harrison

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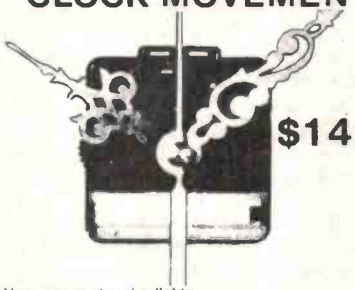

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*As stated in the manufacturers technical literature.

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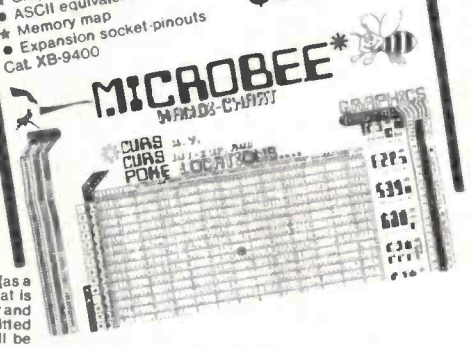

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This fantastic little kit attaches to virtually any car alarm (as a sensor). It sets up an ultrasonic field inside the car that is virtually immune to false triggering. A special transmitter and receiver unit is supplied that can be unobtrusively fitted inside the cabin. Any movement inside the cabin will be detected and a trip signal sent to your car alarm.
Complete kit and instructions. Cat. KJ-6650

ONLY $49.50

SPECIFICATIONS:

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- ★ Samples/Sec - 1.6
- ★ Temperature Stability - 50ppm/°C typical
- ★ Temperature Range - 0-35°C
- ★ Supply Voltage - 7.5 - 15V
- ★ Supply Current - 1mA typical

Maximum DC Input Voltage - ± 20V

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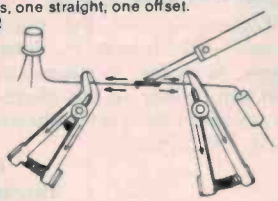

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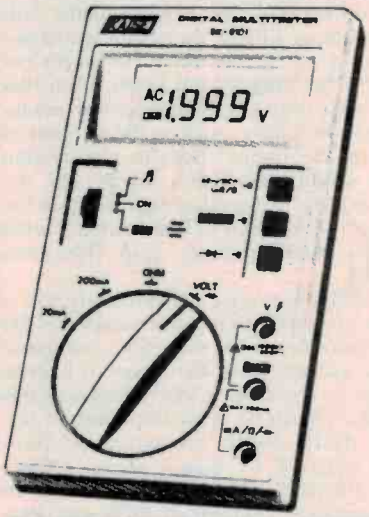

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. . . more rage over Sphere review

Dear Sir,
As you will no doubt be aware, the publishing of a product review carries with it an editorial responsibility to ensure that the material is fair and accurate. I was therefore quite horrified by the gross errors and ill-disguised bias to be found in your review of the Sphere MkII in the February 1984 issue of ETI.

Being the owner of a computer very similar in specifications to the product under review, and using a variety of business and large mainframe computers on a day to day basis, I think you will agree that I am well qualified to make such an observation.

My criticism of the review broadly falls into two areas. Firstly, the review contains a number of statements which are simply not correct. This ranges from information that could have been obtained from the manufacturer's literature, such as the number of sides on the floppy disk, to information which would have been known to the reviewer if he had general experience in the computer field, such as who manufactured the first microcomputer chip (Motorola indeed!).

Secondly, the reviewer obviously has a preconceived notion of what constitutes the most desirable architecture for a computer system. In fact, from the review it is even possible to construct a specification of this machine, viz: 16-bit microchip, in-built terminal, DOS boots automatically, commands selected by menu, screen editor, fancy BASIC commands presumably to drive graphics, customised DOS etc. Perhaps he owns an IBM PC.

Unfortunately, it would appear that the reviewer does not have sufficient knowledge of the subject to be aware that there may be advantages in using 'the other approach'. A typical example is his strong preference for an in-built terminal. Those in the industry will be well aware that the best solution depends largely on the application. The net result is that a great deal of the criticism directed at the Sphere merely reflects the reviewer's own personal opinion. It is tragic that personal bias and prejudice should constitute the major part of a product review.

This leads to the question of who is your Jonathan Scott? Normally in such an article, the author's academic qualifications and experience are included so that the reader can ascertain what faith can be placed in the material. Is it possible that he has none? The immaturity of his writing and lack of knowledge suggest a high school or university student. He is certainly not a technical writer, otherwise he would not have violated several trade names and placed the publisher at risk of prosecution.

Unfortunately, many people place implicit faith in the printed word in the media. For the manufacturer this means that he may as well close his business — no one is going to buy a Sphere after reading your article. At a time when most computer vendors are content to merely import products and resell them without any local content or customisation, I think that this is very shabby treatment indeed.

Regrettably time does not permit me to discuss your review in detail. I will be happy, however, to discuss or correspond with you further on this matter. Finally, let me say that I have no connection with Paris Radio Electronics.

C. D. Barlow
Turramurra, NSW

Dear Mr Harrison,
As a user of a Sphere MkII M6809 microprocessor I was interested in the review of the system published in the February '84 issue of ETI and, in particular, in the contrast between this review and another review of an earlier model published in Electronics (Jan. '82).

When we consider the increasing use of various processing systems both in the work place and in the home, it is evident that considerable responsibility is incurred in the publication of reviews and that particular care should be taken to present as unbiased an assessment as possible. Every system has its virtues and limitations and the assessment of a particular system should present a balanced view and take into account the tasks for which the system was designed, and the compromises that result in optimising a system towards a particular role.

For example, your reviewer expressed disappointment that the Sphere VDU and keyboard are not integrated into the computer housing. For single user systems this can be a desirable arrangement, but it is inappropriate for multi-user operations. Some of the marked advantages of the Sphere system are its ability to be expanded to multi-user operations, its ability to use expanded memory addressing and in its capacity to install a range of periphical (sic! — Ed.) communication boards.

The capacity of the M6809 processor is quite adequate for many multi-user applications, particularly in small business operations. Consequently the unsupported statement, "However, the Sphere isn't really up to multi-user operation . . ." should be either qualified or withdrawn.

The VDU is a low cost, versatile unit capable of emulating a number of other popular systems and is well suited to its application.

Your reviewer also refers to the use of a pin-and-socket arrangement for connection to the motherboard and expresses a preference for gold-plated edge connectors. He is either unaware, or did not consider it worth mentioning, that this pinning arrangement is part and parcel of the SS50 buss for which a wide range of manufacturers provide compatible boards. This standardisation is a major feature in enabling a system to be expanded at low cost, without being tied to the whims of a single manufacturer. Furthermore, the use of a standard buss makes it economic for manufacturers to produce compatible boards with more powerful processors, as they become available, without the need to abandon the majority of the hardware.

I was pleased to see that the Flex operating system was more fairly treated, but even here the virtues of having a widely used and versatile system was downgraded by the comment ". . . a buyer would have to put a lot of value on having a system with extensive software backup to justify the expense." The cost involved in developing software can rapidly exceed the cost of hardware and the ability to use a system for a wide range of tasks (usually unforeseen when purchasing the system) is a major reason for the rapid growth in microprocessor use. The ability to rapidly transfer programs from system to system, and to be able to call on an extensive range of programs, can over-ride many other considerations influencing the choice of a system.

Many purchasers of advanced systems using new technology find that the range of software is limited, that bugs in the existing software can drastically reduce the usefulness of the system, and that it may be months or years before the full capabilities of the system can in fact be realised.

The choice of system depends heavily on the tasks to be undertaken, the technical and programming personnel available, and on the support facilities already available. The rapid development of improved microprocessors and the reduction in costs associated with their ready acceptance by the community will undoubtedly continue and will further complicate and confuse those attempting to decide which systems are best suited to their needs.

If the reviews in your publication are intended to educate and inform your read-

ers as to the strengths and weaknesses of various systems, I suggest that your reviewers should be encouraged to develop a broader point of view than that displayed by Jonathan Scott in his review of the Sphere MkII.

Dr Ian A. Bourne
Nunawading, NSW

Dear Sir,
I was surprised when I read Jonathan Scott's review of the Sphere computer and terminal, published in 'Electronics Today International', February, 1984.

As the owner of two Sphere computers and two terminals I am completely satisfied with their performance. In fact, their acquisition has been of great benefit to this company, indeed, proving to be one of our greatest assets.

Contrary to the statement in the review, I use 5¼" double-density, *double*-sided floppy disk drives with our Sphere computers.

I cannot agree with Scott's description of the CCT-100 as being "substantially unintelligent" as it can equal the functions of many other terminal modes. I have always understood that a terminal possessing a microprocessor is invariably an intelligent terminal.

In conclusion, both my Sphere systems have proved to be capable, efficient and, best of all, relatively easy to operate. I consider that I have received good value for my money.

Malcolm W. Rigby
Sydney Lock and Key Co.

Dear Sir,
I read with dismay Jonathan Scott's review of the Sphere MkII computer in ETI, February 1984. In my opinion, it would have to rank as one of the most uninformed computer reviews that I have ever seen.

Mr Scott has done a great disservice to the many 6809 users in this country by expounding on a subject area in which he apparently has little or no experience. A rebuttal of his comments on the Sphere MkII computer system is best left to the manufacturer of this system, but I would like to take issue on two factors which emerged from the article.

Mr Scott leaves the reader with the impression that the only reason for the 6809's existence is as an "enhanced 6800 microprocessor". The impression is simply not valid — whilst the 6809 does have compatibility with the 6800 at the Source Code level, the 6809 is a separate microprocessor in its own right. The 6809 has a far more efficient and powerful instruction set than does the 6800, and it is considered by many people (myself included) that the 6809 is the best 8-bit microprocessor that is available today.

Mr Scott also makes a mistake in stating that the Flex Operating System is "... related to OS9" — that is simply not true. These operating systems were written by different companies (OS9 by Microware, Flex by TSC) and the capabilities of both are completely different.

A very brief contrast between them shows that OS9 is a real-time multi-user, multi-tasking operating system. It supports hierarchical directory structures, it is modular in construction and it is readily adaptable to different computer configurations. In contrast, Flex is a non-real-time, single-user, single-task operating system which does not support hierarchical directory systems, and is more difficult to adapt to different systems than is OS9.

The differences between these two operating systems is immense, and one could say that the only similarity between the two is the fact that they both use the same microprocessor chip.

I suggest that in future Mr Scott restrict himself to subject areas in which he is experienced, and not to make uninformed and incorrect statements on subjects he obviously does not understand.

Warren W. Brown
Microprocessor Consultant
Wagga Wagga, NSW

Dear Sir,
I am prompted to correspond following my perusal of Jonathon Scott's revue of the Sphere MkIII published in ETI, February 1984. It is immediately apparent after reading the first paragraph that not much effort was spent reading the manuals supplied.

The disk drives are double-sided, double density and not single-sided. Both 40 and 80 track drives are available and the controller can accommodate up to four drives. The 6800-based CCT-100 terminal is not "unintelligent" as it can emulate a variety of other terminal modes.

Somehow the MkIII has been tagged as a small business system and, when run as a multi-user system with Flex and Dyna-share or perhaps Uni-Flex, this is so. Because of the availability of some excellent assemblers, dis-assemblers and cross-assemblers, it is also ideal as a development system.

Running Flex on the MkIII allows plenty of scope for future applications, too many of which are always overlooked when buying any system regardless of the initial application. Mr Scott makes no mention of the business packages available for the Sphere and vaguely refers to languages such as Pascal, C etc. which are suited to the 6809 and its extended addressing. The MKIII, in fact, can accommodate up to 1M of RAM.

His comments on the editor are justified, although I couldn't imagine any business using a line editor rather than a word processor.

Entering the monitor before booting the DOS may become tiresome when debugging programs but for business applications it shouldn't present any hassles. Use of the STARTUP facility and the EXEC command allow most of the initial boring chores to be undertaken with one command.

It is a pity that many Flex-09 users have to deal with endless articles on CP/M et al, and I am disappointed to find that such a poorly researched article should appear in your otherwise excellent magazine.

The Sphere MkIII is a locally made product with excellent support — a blessing for those who appreciate the 6809 and the quality of hardware and software available.

Keith McPherson
Glebe, NSW

Dear Sir,
Now that digital audio has been pushed and accepted into the domestic market as the new and future sound medium, I would like to know what you think of either upgrading existing loudspeakers or producing new types to cope with the more demanding requirements of digital processing and to do justice to its capabilities.

It seems to me that with an available dynamic range (amplifier permitting) of at least 85 dB (assuming digital recording and mastering), a ruler flat response from 5 Hz to 20 kHz and midrange distortion of around 0.005%, there is now a real need to produce loudspeakers and enclosures to deliver these specifications to our ears.

I am aware of the current trend towards flat diaphragm, honeycomb woofers which both Sony and Technics are producing, and I'm aware of the possible reduction in non-linear distortions which can be achieved, but when a price tag of $15 000 is placed on Sony's APM 8s, a four-way system, I find that any sonic benefits fall far short of the exhorbitant price.

Can conventional cone drivers do justice to the new requirements and, if so, what changes are necessary? Do we need woofers with larger cone excursions? Should we opt for subwoofers to cope with the extra bottom-end information? Should we be dropping Thiele and Small bass reflex designs with its dangerous cone excursion below resonance and go for a combination of large sealed enclosures and subwoofers? What of the tweeters? Perhaps the answer is in ribbon electrostatics to faithfully reproduce those sparkling top end transients.

There are so many possibilities, the list could be endless. I have already read advertisements of various manufacturers boasting of speaker systems designed specifically to cope with digital needs. However, on inspection of the specifications and on comparative listening tests against the Tannoy, JBL and B&W speaker systems I find no improvement.

Which way should one go to pursue the (dare I say it) transparent speaker system capable of satisfying the new heavy requirements placed on them by the advent of PCM and the compact disc. ▶

LETTERS

I would greatly appreciate any views you may have on the matter. I realize that it is not your policy to venture into discussion on non-project type queries. However, with your magazine's reputation for being at the forefront of innovation and technical nouse (i.e: David Tilbrook), a great many readers would be interested in finding out the facts and what they can do to deliver the attractive specifications to their ears.

Congratulations on a consistently high quality publication.

Maurice Little
Rowville, Vic.

You really have opened a 'can of worms'. To try to do justice to your letter in the limited space the editor will allow me is probably asking too much.

As you correctly deduced, the speakers that were previously good enough for conventional records or tapes are not proving to be as suitable for the more demanding performance capabilities of compact discs. The basic problem, of course, is a little like 'the six blind men walking around the elephant'; each of them describes the beast in a different way, depending on where he happens to be standing.

For example, if someone has never experienced good speakers, then the CD medium sounds exciting. By contrast, a person who is aware of the differences between the sound produced by poor speakers and the original recorded sound may be disappointed with speakers that have obvious limitations or reveal gross deficiencies when used with a CD player.

As with conventional records and tapes, the quality of the loudspeakers must relate directly to the quality of the recording; not everybody is likely to play 'Tchaikovsky's 1812' with the full 90 dB dynamic range required by the cannons or frequency components extending down to 10 Hz.

As with everything in life, one has to make compromises which are determined by personal factors. You will have to decide how much money you wish to spend on speakers in your quest for perfection, which you may approach but will never really achieve.

Louis Challis
Kings Cross, NSW

Dear Sir,
Thank you for Collyn Rivers' most informative article in your February 84 issue. I am a Service Engineer with Rank Xerox and Product Specialist on the Duplicator range of copiers. The 7000 model is full of 14-pin mini-relays switching 115 Vac and 230 Vac and 24 Vdc with resistive, capacitive and inductive loads, wet and dry; add a double handful of micro-switches handling the same loads and there you have 50% of our service calls.

As a training exercise I intend to make a presentation to my area ('the Dirty Dozen'), relying heavily on this article and upon field experience. Melbourne Duplicator reliability figures are, we have been told recently, a benchmark for Xerox/Rank Xerox worldwide, and I feel sure that information such as this can help us stay top of the heap.

Garry M. James
Glen Waverley, Vic.

Dear Sir,
The purpose of this compendious communication is not to consume your valuable time, but to express appreciation for your current series of projects related to the Microbee computer.

Please keep this type of material coming, particularly projects and/or articles aimed at the raw beginner in microprocessors. I have not yet even purchased one, but I certainly intend acquiring a Microbee as soon as my spouse increases my pocket money sufficiently!

As an aside, I also find your Circuit File series most useful, the February article on the LM335 being a meritorious example.

Thanks for an enjoyable magazine.

John W. Keitley
Blackburn Sth, Vic.

Dear Sir,
As one of your readers for the past 20-odd years, I find I must voice a very strong protest.

In the past your magazine has been of an excellent standard, providing projects for a wide section of the community. Now, as it should be (let's keep technologically abreast), you have become computer orientated. Fine. But to say you are one-eyed I feel would be a gross understatement.

Let's get one point straight. I do *not* own a Microbee computer! The series of projects and contents of advertising material in your magazine lead one to believe that 90% of the personal computer fraternity do own a Microbee.

However, I do possess a personal computer with all the attributes of the Microbee utilising Extended Microsoft BASIC (colour) and, God forbid, *standard* serial and parallel ports i.e: Centronics and RS232.

Would it be too much to ask for a couple of projects as add-ons to cater for your other poor unfortunate readers who are in a similar position and who cringe at the cost of commercial (if available) peripherals.

How about a go, ETI? It would appear that the only sin I have committed is in not following in the footsteps of others.

Robert Green
Melton South, Vic.

If you've been reading ETI for the past 20-odd years, could you please inform us who published it for the seven-odd years before April 1971? We'd like to know so we can get back issues before our Issue No. 1!

Thanks for the bouquets, now for the brickbats. So you (and many other readers) do not own a Microbee. Fair enough. However, it rapidly became clear to us last year that a huge number of 'Bee owners were 'hackers', unafraid of a soldering iron and well-prepared to construct add-ons for their equipment. We tried the odd project for other computers previously (like the Apple, System 80, S100 systems), as well as projects applicable to a variety of machines, but they never met with the spectacular acceptance and enthusiasm that the Microbee projects have.

In addition, we have not received one article from other-computer owners who have attempted modifying 'Bee projects to suit their computer. Some of the 'Bee projects can clearly be adapted to other computers (the RTTY decoder and Fax decoder, to name two), albeit with most of the adaptation involving the software.

The thing is that, here, we have neither the expertise on-staff, nor the time to research and write it up for a host of other machines. What other machines do we pick? On what basis? These questions have been addressed by us, but it's difficult to come up with clear answers and we have few 'indications' from either readers or the marketplace.

The real problem for us is the huge variety of machines, each using a different processor and having different architectures. So there's a lot of VIC-20s out there — but too few owners seem willing or capable of tackling projects. It's an entirely different story with the Microbee in our experience.

Also, we receive very, very few technical articles on additions and modifications for other computers. It's the opposite situation with the Microbee. In fact, I'm unable to publish all that I receive. Then again, most of the published Microbee projects have been submitted by readers (. . . and proved by constructing them in our own lab.) or adapted from submitted reader's ideas.

All that aside, we *are* attempting to do more peripheral projects suitable for a wide variety of computers. Project 675, the RS232-Centronics interface (Jan. '84), is a recent example.

Your remark on the advertising content underlines what seems to be a common misunderstanding of how the advertising comes to appear in ETI. Advertisers *purchase* the space and it's their business what they advertise there. *We* don't put the advertisements there, nor do we tell them what to advertise. That's entirely their prerogative.

An objective count of the advertising and the products advertised will show you that the Microbee does not predominate. Sure, it figures pretty often and the advertising clearly works, else it wouldn't still be there month after month.

Here's a challenge to non- 'Bee owners. If I get a small deluge of technical articles, software, hints and tips supporting a particular machine, I'll consider running either regular articles or a regular column. Any takers? In any case, good articles or software to suit popular machines are always in demand and I'm happy to consider submissions.

Roger Harrison
Editor, ETI.

MINI-MART

Where readers can advertise For Sale/Wanted/Swap/Join.

AUDIO

FOR SALE: STEREO amp, 12 W per channel, 240 Vac and 12 Vdc power, compact size, LED level meter, $79, M. Sully, 33 Odessa Ave, Keilor Downs Vic. 3038.

FOR SALE: SUPERB Quad II power amps (2) and Quad 22 control unit, $280 the lot. K. Jordan, G.P.O. Box 2140, Brisbane. (07)369-5830.

AMPEX MM1000 one inch, eight track, perfect condition, $6700. (03)26-4367 ah or (03)609-8485 bh.

FOR SALE: J. H. Formula 4 tone arm, mint condition, $60. Transcriptor Fluid arm, $80. (02)869-1840.

FOR SALE: QUAD preamp Model 22, valve unit, good condition, $70 ono. (02)869-1840.

FOR SALE: ELECTROSTATIC headphones, Stax SR-3, complete with SRD-6 energiser. Superb clarity, mint condition, $80 ono. (02)869-1840.

FOR SALE: TEAC A3440 four channel, 10.5 inch reel-to-reel recorder with Simul-sync, ideal for musicians and multi-track recording, as new, $985. Epping NSW. (02)869-7247.

MISCELLANEOUS

FOR SALE: TELEQUIPMENT scope, Model S43, small size 8"x9"x14" (lightweight), offers please. J. Double, 3/57 Wattle Ave, Brighton SA. (08)298-7541.

FOR SALE: 50 copies of Radio & Television & Hobbies, 1943-1960. C. Beach. c/- P.O., One Tree Hill SA. (08)380-7014.

FOR SALE: BWD 246A programmable power supply, $700. Peter Anderson (02)605-7080.

WANTED: CIRCUIT for Fairchild Model 701 CRO made by Dumont Laboratories, also a low power laser tube. (02)570-7212.

FOR SALE: RADOFIN UHF Teletext adaptor, three months old with remote control. Cost $495, sell for $200. J. Collier, P.O. Box 234, Randwick NSW 2031.

FOR SALE: PRINTER Anadex 9620A 'Silent Scribe', 200 cps, 1.5K buffer, multiple fonts, RS232/Centronics, 12 months old. New $2580, sell for $1150 ono. Gil (09)390-5420 ah.

WANTED: CIRCUIT diagram for B&W portable TV General Appliance Corporation of Australia, Model SW-T316C. Ian Adamyk, 22 Willana Ave, Nth Geelong Vic. 3215.

WANTED: LASER, perhaps used ETI or EA project, any power. Needed for projects and experiments. T. Barker, P.O. Box 332, Parkes NSW 2870.

COMMUNICATIONS

FOR SALE: TELEPRINTER, Siemens T100, 50 baud, current loop, 5-bit machine, $70 ono. Reg (03)367-4496. St Albans Vic.

FOR SALE: RF signal generator, Avo No.2, 450 kHz to 225 MHz, CW, AM, FM, int/ext. modulation, variable AM% mod, FM deviation to ±75 kHz, good condition, $195. (07)265-1961.

WANTED: ARMY wireless set No. II, plus any parts. Also AWA 3BZ, Radio Corporation 108, 208. Enthusiast. M. Kelly, Olinda Rd, The Basin Vic. 3154. (03)762-3993.

COMPUTERS

AZUA: Bi-monthly newsletter for all Sinclair computers. Send two 30c stamps to 19 Godfrey St, Campbell ACT 2601 for introductory newsletter.

FOR SALE: TEXAS Instruments, translates, speaks words, phrases and sentences, displays them electronically, 3000 phrases, Spanish module, half price, $150. Jose (02)745-4281 ah.

WANTED TO SWAP: TRS80 Model I level 2 computer programs. Geoff Egel, 18 Sturt St, Loxton SA 5333.

FOR SALE: APPLE IIe, two drives, green screen, heaps of software, worth $8300, sell for $3200 ono. (02)529-6485.

FOR SALE: OSI C2-4P, 32K RAM, 24K ROM, BASIC, word processor etc, in-built. 64x32 display. Has speech output under BASIC control using print type statement. W. Geary, 83 Second Ave, Rossmoyne WA 6155.

FOR SALE: SUPER 80 disassembler converts Z80 binary instructions to mnemonics, $9. Siemens M100 teleprinter, $45. R. Vowels, 93 Park Dv, Parkville Vic. 3052.

VIC-20 PROGRAM LIBRARY: High quality games, utilities, educational and miscellaneous programs available. Send SAE to Chris Groenhout, 25 Kerferd St, Watson ACT 2602 for list.

ACT VIC-20 bi-monthly newsletter: Many interesting articles and programs. April issue $2. Bi-monthly $12 per year. Write to Chris Groenhout, 25 Kerferd St, Watson ACT 2602.

FOR SALE: 32K EPROM board and programmer for TRS80 model I. Has parallel printer and 20 mA loop capability. Complete with manual, power supplies and one EPROM, $240. G. Johnson (03)337-4959.

WANTED: Can anyone supply a copy of complete manual for 'Screen Writer II', will pay. K. Jordan, G.P.O. Box 2140, Brisbane. (07)369-5830.

VIC-20 SOFTWARE: UMI cartridges Renaissance and Spiders of Mars, $14 each. EPYX cassette (+8K) Ricochet, $12. Tronix cassette (+8K) Sidewinder, $15. Paul (02)560-3462.

FOR SALE: MSI/SWTPC M6800 computer, 8" floppy, 5x5M hard disk, Teleray 3300 80x24 VDU, ASR33 teletype, Flex O/S and other S/W, Univac keyboard with 64x16 VDU card. Will separate, best offers. John (03)306-7660 ah.

FOR SALE: ZX80/81 Abacus controller, talk, save, cue, load, built-in speaker, brand new, $22 including postage. E. Brown, P.O. Box 1315, Southport Qld 4215.

FOR SALE: SORCERER MK2, 48K with ROM-PAC BASIC and wordprocessor, 40-track disk drive SSDD, manuals and software. Thomas Nuy (02)789-1105.

WANTED: INFORMATION on public data base use for new Microbee user. If you can help write to Robert Schenk, P.O. Box 177E, Ballarat East Vic. 3350.

FOR SALE: S100 cards, DG640 64x16 VDU, $90. SPC-29 multi I/O 2xRS232C and 9x8-bit directional parallel with cables, $225. Both excellent condition. Russell (03)657-3215 bh or (03)20-6100 ah.

FOR SALE: DICK Smith System 80, 16K level 2, with modifications, in full working order, $100. J. Collier, P.O. Box 234, Randwick NSW 2031.

FOR SALE: PROGRAMS for TRS80/System 80 computers. Hundreds of original programs on 106 cassette tapes, $100. J. Collier, P.O. Box 234, Randwick NSW 2031.

WANTED TO BUY: Used Big Board 2, working or not or partially assembled kit. Write with details to G. Wiencke, c/- G.P.O. Box X2212, Perth WA 6001.

FOR SALE: Z80 development system Tec-1, by Talking Electronics, $50 ono. Complete with manuals and power supply. Mark (02)872-3407.

FOR SALE: ETI-660 computer, colour expansion, 3K RAM, $140 ono. VIC Innovative Computing, $7. Tandy electronic basketball game, $9. Solar cell, $8. B. Begg (08)31-0310.

MICROBEE: WIMBLEDON tennis game, for one or two players, three skill levels, tape and listing, only $5. T. Knowler, 9 Waterman Place, Fraser NSW 2615.

FOR SALE: DGZ80 CPU, $100. ETI-640 VDU, $100. S100 power supply, $50. Keyboard in enclosure, $50. Dick Smith B&W monitor, $100. Cliff (02)604-3819 ah.

FOR SALE: VIC-Maths for VIC-20. Improves your maths skills, grades 1-8, $13. (02)649-2283 after 4pm.

DREGS

THERE WAS A TIME, you know, before the "electric power" mains were reticulated to every home in the nation, when the hobby of electronics (or 'electro-mechanics', or 'wireless', as it was then called) was a dangerous pursuit for young men. We recently came across a quaint passage in a delightful little circa-1911 book titled *Wireless Telegraphy for Amateurs* that warned of the dangers of the hobby. In the section on *Receiving Apparatus* appeared two paragraphs suggesting various uses and experiments. Have a dekko at this lot:

For making the receiver light up lamps, blow fuses, etc., switch-devices may be operated by trigger-mechanisms which are released by the movement of an electric-bell-hammer. Details of design must be left to the ingenuity of the reader.

For exploding cartridges, etc., a convenient fuse can be made quickly by soldering a short length, say ⅛ in, of the finest platinum wire to two pieces of No. 26 copper wire. These are laid one on each side of an ordinary wooden match, so that the platinum wire bends over the head of the match and lies in contact with it. the copper wires are then bound to the match with cotton. This fuse is inserted in the explosive to be fired.

Connection is made to the fuse by twisting wire on to the two ends of the copper, and the current to heat the platinum is supplied by one accumulator or bichromate cell, or even by a good dry cell. Explosions should not take place near to the receiver.

* Apologies to Robert Burns (Ode to a Field Mouse) and Ion L. Idriess (Lasseter's Last Ride).

* Makes today's hobby look tame by comparison!

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